

5

100

1

100

100

100

CHANGE }
NO 3 }

HEADQUARTERS DEPARTMENTS
OF THE ARMY AND U S MARINE CORPS
WASHINGTON, D C , 4 November 1986

Direct and General Support Maintenance Manual

BOAT, BRIDGE ERECTION, TWIN JET, ALUMINUM HULL,
MODELS USCSBMK1 (1940-01-105-5728) AND USCSBMK2 (1940-01-218-9165)

TM 5-1940-277-34, 1 August 1984, is changed as follows

1 The U S Marine Corps is being added to this change

2 Remove and insert pages as indicated below New or changed text material is indicated by a vertical bar in the margin An illustration change is indicated by a miniature pointing hand

Remove pages

a and b
1/11
1-1 through 1-10
2-3 and 2-4
2-9 and 2-10

2-11 and 2-12
2-21 through 2-24
2-27 through 2-29/2-30
2-51 through 2-55/2-56
2-57 and 2-58
2-87 and 2-88
2-93 and 2-94
2-103 and 2-104
2-161 through 2-164
2-169 and 2-170
2-179 through 2-190

2-241 and 2-242
2-245 and 2-246
2-307 and 2-308
2-313 and 2-314
2-317 through 2-322
2-355 through 2-362
3-1 and 3-2
3-71 and 3-72
3-75 through 3-78
3-81 through 3-84
A-1 and A-2
I-1 and I-2
FO-3

Insert pages

a and b
1/11
1-1 through 1-12
2-3 and 2-4
2-9 and 2-10
2-10 1 through 2-10 6
2-11/2-12
2-21 through 2-24
2-27 through 2-29/2-30
2-51 through 2-55/2-56
2-57 and 2-58
2-87 and 2-88
2-93 and 2-94
2-103 and 2-104
2-161 through 2-164
2-169 and 2-170
2-179 through 2-190
2-190 1/2-190 2
2-241 and 2-242
2-245 and 2-246
2-307 and 2-308
2-313 and 2-314
2-317 through 2-322
2-355 through 2-362
3-1 and 3-2
3-71 and 3-72
3-75 through 3-78
3-81 through 3-84
A-1 and A-2
I-1 and I-2
FO-3

FM 5-1940-277-34

FM 5-1940-34/3

C 3

By Order of the Secretaries of the Army, and the Marine Corps

JOHN A WICKHAM, JR
General, United States Army
Chief of Staff

Official.

R. L. DILWORTH
Brigadier General, United States Army
The Adjutant General

Official

GEORGE B CRIST
Lieutenant General, USMC
Deputy Chief of Staff for Installations and Logistics

DISTRIBUTION

To be distributed in accordance with DA Form 12-25A, Direct and General Support Maintenance requirements for Boat, Bridge Erection, Twin Jet, Aluminum ' "K-1

CHANGE }
NO 2 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON D C , 1 August 1984

Direct and General Support Maintenance Manual

**BOAT, BRIDGE ERECTION, TWIN JET,
ALUMINUM HULL Model USCSBMK 1 (1940-01-105-5728)**

TM 5-1940-277-34, 10 November 1981, is changed as follows

1 Remove and insert pages as indicated below New or changed text material is indicated by a vertical bar in the margin An illustration change is indicated by a miniature pointing hand

Remove pages

1-3 and 1-4
2-1 and 2-2
2-11 and 2-12
2-15 and 2-16
2-27 and 2-28
2-39 through 2-48
3-1 and 3-2
FO-1 1
FO-1 2

Insert pages

1-3 and 1-4
2-1 and 2-2
2-11 and 2-12
2-15 and 2-16
2-27 and 2-28
2-39 through 2-48
3-1 and 3-2
FO-1 1
FO 1 2

2 Retain this sheet in front of manual for reference purposes

By Order of the Secretary of the Army

JOHN A WICKHAM, JR
General, United States Army
Chief of Staff

Official

ROBERT M JOYCE
Major General, United States Army
The Adjutant General

DISTPIBUTION

To be distributed in accordance with DA Form 12-25D, Direct and General Support Maintenance Requirements for Special Equipment, Boat Bridge Erection

M 5-1940-277-34

M 5-1940-34/3

C 3

By Order of the Secretaries of the Army, and the Marine Corps

JOHN A WICKHAM, JR
General, United States Army
Chief of Staff

Official

R. L. DILWORTH
Brigadier General, United States Army
The Adjutant General

Official

GEORGE B CRIST
Lieutenant General, USMC
Deputy Chief of Staff for Installations and Logistics

DISTRIBUTION

To be distributed in accordance with DA Form 12-25A, Direct and General Support Maintenance requirements for Boat, Bridge Erection, Twin Jet, Aluminum USCSBMK-1

CHANGE }
NO 2 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON D.C , 1 August 1984

Direct and General Support Maintenance Manual

**BOAT, BRIDGE ERECTION, TWIN JET,
ALUMINUM HULL Model USCSBMK 1 (1940-01-105-5728)**

TM 5-1940-277-34, 10 November 1981, is changed as follows

1 Remove and insert pages as indicated below New or changed text material is indicated by a vertical bar in the margin An illustration change is indicated by a miniature pointing hand

Remove pages

1-3 and 1-4
2-1 and 2-2
2-11 and 2-12
2-15 and 2-16
2-27 and 2-28
2-39 through 2-48
3-1 and 3-2
FO-1 1
FO-1 2

Insert pages

1-3 and 1-4
2-1 and 2-2
2-11 and 2-12
2-15 and 2-16
2-27 and 2-28
2-39 through 2-48
3-1 and 3-2
FO-1 1
FO 1 2

2 Retain this sheet in front of manual for reference purposes

By Order of the Secretary of the Army

JOHN A WICKHAM, JR
General, United States Army
Chief of Staff

Official

ROBERT M JOYCE
Major General, United States Army
The Adjutant General

DISTRIBUTION

To be distributed in accordance with DA Form 12-25D, Direct and General Support Maintenance Requirements for Special Equipment, Boat Bridge Erection

1

CHANGE }
NO. 1 }

TM 5-1940-277-34
C 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 10 May 1982

Direct and General Support
Maintenance Manual

BOAT, BRIDGE ERECTION
TWIN JET, ALUMINUM HULL

Model USCSBMK 1
(1940-01-105-5728)

TM 5-1940-277-34, 10 November 1981, is changed as follows

1 Remove and insert pages as indicated below

	Remove pages	Insert pages
Warning Page	a and b	a and b
Table of Contents	i/ii	i/ii
Chapter 1	1-1 and 1-2	1-1 and 1-2
	1-5 and 1-6	1-5 and 1-6
Chapter 2	2-3 thru 2-6	2-3 thru 2-6
		2-6 1/2-6 2
	2-7 thru 2-10	2-7 thru 2-10
	2-13 thru 2-18	2-13 thru 2-18
		2-18 1 and 2-18 2
	2-19 thru 2-25/2-26	2-19 thru 2-25/2-26
	2-45 and 2-46	2-45 and 2-46
	2-55/2-56	2-55/2-56
	2-145 thru 2-150	2-145 thru 2-150
	2-173 thru 2-177/2-178	2-173 thru 2-177/2-178
	2-183 and 2-184	2-183 and 2-184
	2-227 and 2-228	2-227 and 2-228
	2-259/2-260	2-259/2-260
	2-317 and 2-318	2-317 and 2-318
	2-325/2-326	2-325/2-326
	2-333 and 2-334	2-333 and 2-334
	2-353 and 2-354	2-353 and 2-354
	2-367 thru 2-381/2-382	2-367 thru 2-381/2-382
	2-427 and 2-428	2-427 and 2-428
Chapter 3	3-129 and 3-130	3-129 and 3-130
	3-139 thru 3-142	3-139 thru 3-142

2 New or changed text material is indicated by a vertical bar in the
margin An illustration change is indicated by a miniature pointing hand

3. Retain this sheet in front of manual for reference purposes

by Order of the Secretary of the Army

Official

E C MEYER
General, United States Army
Chief of Staff

ROBERT M. JOYCE
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION

To be distributed in accordance with DA Form 12-25D, Direct and General Support Maintenance Requirements for Special, Boat Bridge Erection

WARNING

SERIOUS INJURY OR DEATH

may result if personnel fail to observe the following safety precautions.

Batteries give off explosive hydrogen gas. Be careful making connections. Do not smoke when servicing the battery.

Be sure the master battery switch is off before disconnecting or connecting battery cables.

Always disconnect the ground cable first and connect it last. Make sure the POS (+) and NEG (-) connections are correct.

Do not ground the positive terminal of batteries to boat structure.

Do not operate engines in an enclosed area without adequate ventilation as carbon monoxide, an invisible poisonous gas, is generated. Symptoms of exposure to carbon monoxide are headache, dizziness, drowsiness, loss of muscular control and coma. Severe exposure can cause permanent brain damage.

Wear life preservers (work vest) at all times when aboard the boat

Do not allow personnel between boats during slave starting.

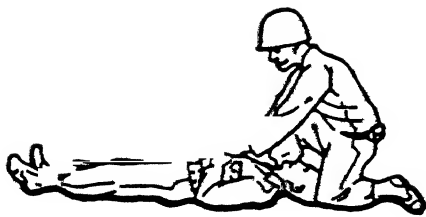
Maintenance procedures for the fuel system must be performed in a well-ventilated area. Do not allow sparks or flame in the vicinity

Before performing any repair on the electrical system, place master switch OFF and disconnect negative battery cables.

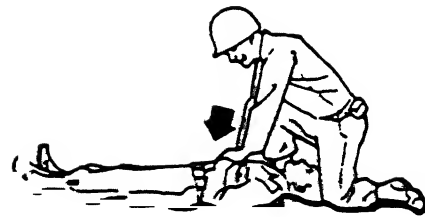
For Artificial Respiration, refer to FM 21-11

Ear protection (ear plugs) must be worn when operating this boat

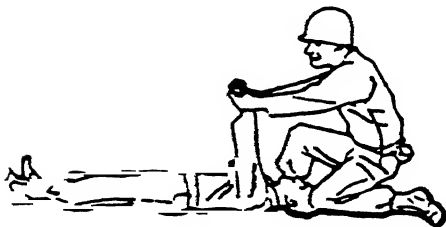
When working near mast assembly, avoid striking head on protruding parts of mast assembly. To avoid injury, be aware of mast assembly position when working below mast



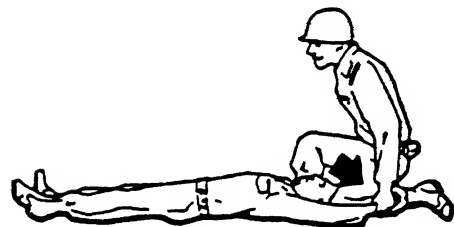
(a) HAND ON LOWER RIBS



(b) STEADY PRESSURE DOWNWARD



(c) ARMS LIFTED UPWARD



(d) ARMS BACKWARD AS FAR AS POSSIBLE

MOUTH--TO--MOUTH RESUSCITATION



NOSE SEALED WITH THUMB AND FINGER



OBSERVE RISE AND FALL
OF SOLDIER'S CHEST

HAND BEHIND HEAD

Figures from FM 21-11

TECHNICAL MANUAL

HEADQUARTERS, DEPARTMENT OF THE ARMY
 HEADQUARTERS, U S MARINE CORPS
 WASHINGTON, D.C 15 June 1986

Direct and General Support Maintenance Manual

BOAT, BRIDGE ERECTION, TWIN JET, ALUMINUM HULL,
 MODELS USCSBMK1 (1940-01-105-5728) AND USCSBMK2 (1940-01-218-9165)

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, Headquarters, U.S. Army Troop Support Command, ATTN AMSTR-MCTS, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. A reply will be furnished you

Marine Corps users shall submit NAVMC Form 10772, Recommended Changes to Technical Publications. Send to Commanding General, Marine Corps Logistics Base (Code 850), Albany, GA 31704-5000

	Page
CHAPTER 1 INTRODUCTION	1-1
Section I General Information	1-1
Section II Equipment Description	1-1
CHAPTER 2 DIRECT SUPPORT MAINTENANCE INSTRUCTIONS	2-1
Section I Repair Parts, Special Tools, Test, Measurement, and Diagnostic Equipment (TMDE), and Support Equipment	2-1
Section II Troubleshooting Procedures	2-1
Section III Direct Support Maintenance Procedures	2-27
CHAPTER 3 GENERAL SUPPORT MAINTENANCE INSTRUCTIONS	3-1
APPENDIX A REFERENCES	A-1
APPENDIX B EXPENDABLE SUPPLIES AND MATERIALS LIST	B-1
APPENDIX C ILLUSTRATED LIST OF MANUFACTURED ITEMS	C-1
APPENDIX D GLOSSARY	D-1
ALPHABETICAL INDEX	I-1
WIRING DIAGRAM.	FO-1
FUEL SYSTEM DIAGRAM	FO-2
COOLING SYSTEM DIAGRAM	FO-3

11

CHAPTER 1

INTRODUCTION

Section I. GENERAL INFORMATION

1-1. SCOPE

- a. Type of Manual Direct Support and General Support Maintenance.
- b. Equipment Name and Model Number: Bridge Erection Boat, Twin Jet, Aluminum Hull. The model numbers assigned to this equipment are USCSBMK1 and USCSBMK2.
- c. Purpose of Equipment: Support bridging and amphibious operations. May also be used as a general purpose workboat in support of diving operations and maritime projects, for inland water patrols, and as a safety boat for amphibious river crossings.
- d. Special Limitations on Equipment When used to ferry troops or cargo, the safe carrying capacity is limited to a maximum of 12 fully equipped men or 4400 pounds (2000 kilograms).

1-2 MAINTENANCE FORMS AND RECORDS. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, The Army Maintenance Management System (TAMMS). Marine Corps personnel will prepare and maintain records and report forms as prescribed by TM 4700-15/1, Equipment Record Procedures

1-3 REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS If your boat needs improvement, let us know. Send us an Equipment Improvement Recommendation (EIR). You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Quality Deficiency Report). Mail it to us at Commander, Headquarters, U S Army Troop Support Command, ATTN: AMSTR-QX, 4300 Goodfellow Boulevard, St Louis, MO 63120-1798. U S Marine Corps users are encouraged to submit EIRs in accordance with 1650 17, or submit Quality Deficiency Reports in accordance with MCO 4855 10. Mail it to us at Commanding General (P840), Marine Corps Logistics Base, Albany, GA 31704-5000. We'll send you a reply.

1-4 WARRANTY INFORMATION The Bridge Erection Boat, USCSBMK1, is warranted by Fairey Allday Marine Limited for 12 months. The Bridge Erection Boat, USCSBMK2 is warranted by American Development Corporation for 12 months. The warranty starts on the date found in block 23 of DA Form 2408-9 in the logbook. Report all defects in material or workmanship to your supervisor, who will take appropriate action through your organizational maintenance supervisor.

Section II. EQUIPMENT DESCRIPTION

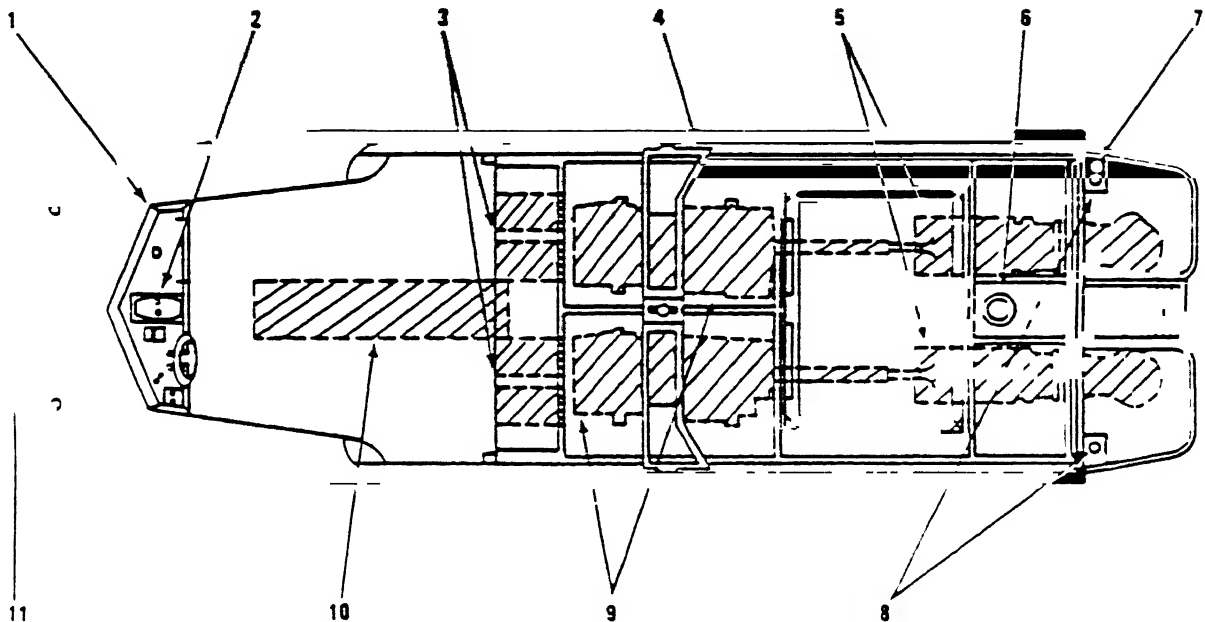
1-5. PURPOSE OF BRIDGE ERECTION BOAT. A transportable, hydrojet propelled, aluminum hull boat designed to maneuver components of floating bridges. The boat can also be used to propel rafts, support diving operations, assist in maritime construction projects, serve as a troop and cargo carrier, and patrol inland waters.

1-6. CAPABILITIES AND FEATURES

- a. Can rotate on its own axis at low engine speeds.
- b. All weather operational.
- c. Transportable by rail, road, and air. (See TB 55-46-1.)
- d. Positive flotation.

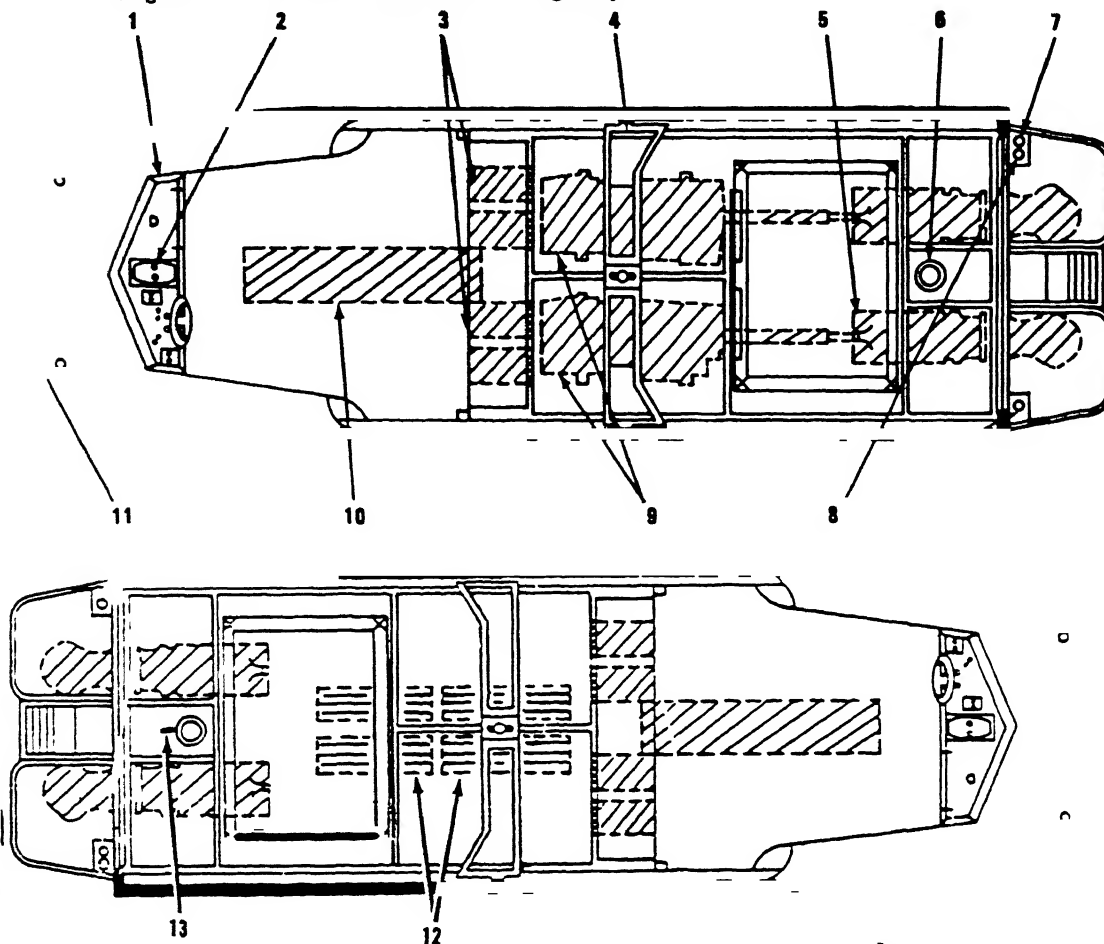
1-7. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

- a. Removable Cab (1) An aluminum frame with windows and aluminum roof that can be attached to the boat to provide protection for the crew during bad weather. The cab is provided with windshield wipers and a place for attaching searchlight.
- b. Control Console (2). Contains all the controls and indicators required for operation of the boat. In addition, it contains a hand-operated bilge pump, a storage compartment for technical manuals, and a storage compartment for life preservers and other gear



- c. Batteries (3) Provide electrical power for the operation of the boat
- d. Removable Mast (4) Contains the navigation lights, towing lights, and anchor lights. May be lowered to rest on capstan or removed from the boat when lights are not required
- e. Hydrojets (5) Consist of diesel engine driven hydrojet propulsion units with directional nozzles and scoops. The propulsion units propel the boat and steer it
- f. Capstan (6) A two-speed hand-operated winching device used for towing, winching, and other work tasks

- g. Davit Tube (7) (MK1 only). Allows the attachment of a davit (small crane) to the boat for use in diving operations. Not used in U.S. Army operations.
- h. Beaching Legs (8). Support the boat in an upright position when on a hard surface and not in cradle. The beaching legs are retractable.
- i. Engines (9). Provide power for driving hydrojet units.
- j. Fuel Tank (10). Provides fuel storage capacity for operation of boat.
- k. Pushknees (11). Provides the front of the boat with a flat vertical surface for pushing barges or maneuvering bridge components. The pushknees can be removed.
- l. Keel Coolers (12) (MK2 only). Provide cooling for the engine, transmission, oil, and turbocharged air. Located on the bottom of the boat.
- m. Tow Hook (13). Provides boat with towing capability. Has quick-release mechanism to allow operator to immediately detach boat from object in tow in case of emergency.



EQUIPMENT DATA

WEIGHTS AND DIMENSIONS

Operating

Weight, w/ crew, equipment and fuel	8800 lbs	(4000 kg)
Length	322.8 in	(820 cm)
Beam	98.0 in	(249 cm)
Height		
w/o cab or mast	77.9 in	(198 cm)
w/ cab	109.8 in	(279 cm)
w/ cab and mast	177.9 in	(452 cm)
Draft		
w/ crew, equipment and fuel	22.0 in	(56 cm)
fully loaded	26.0 in	(66 cm)

Transported

Weight	10800 lbs	(4909 kg)
Length	326.4 in	(826 cm)
Height w/o cab	96.3 in	(244 cm)
Width	116.3 in	(294 cm)

PERFORMANCE

Speed, w/ crew, equipment and fuel	21.6 knots
Speed, fully loaded	16.2 knots
Maximum load carrying capacity	4400 lbs (2000 kg)
Towing hook	4400 lbs (2000 kg)
Turning radius (with scoops at maximum thrust)	
Full speed ahead	2 boat lengths in 15 seconds
Full speed astern	2 boat lengths in 25 seconds
One scoop forward and one scoop in reverse	Standing circle
Fuel consumption (approximate)	
1750 rpm	2 8 gallons/hour (11 liters/hour)
2000 rpm	4 2 gallons/hour (16 liters/hour)
2250 rpm	6.0 gallons/hour (23 liters/hour)
2450 rpm	10 8 gallons/hour (40 liters/hour)
Minimum forward thrust at 2450 rpm	4200 pounds (18.7 kN)
Minimum reverse thrust at 2450 rpm	2200 pounds (9 8 kN)
Maximum safe engine operating speed	
MK1	2800 rpm
MK2	2900 rpm

CAPACITY

Fuel	75 gallons (280 liters)
Oil	
Engine	17-1/2 quarts (16 4 liters)
Transmission	2-1/2 quarts (2 35 liters)
Coolant	
MK1	7-1/5 gallons (27 liters)
MK2	18 gallons (68.1 liters)

ENGINE INSTRUMENT PANEL GAGE READINGS

Tachometer	
Idle speed	650 to 750 rpm
Operating speed	1000 to 2000 rpm
Maximum speed (Under Load)	2500 rpm
Engine oil pressure gage	
Idle speed	20 to 30 lb/in ² (1 4 to 2 1 Kp/cm ²)
Operating speed	40 lb/in ² or ² above (2 8 Kp/cm ²)
Coolant temperature gage (fresh water system)	
Normal	Below 195°F (90°C)
Overheating	Above 195°F (90°C)
Battery condition meter (engine not running, no electrical load)	
Battery fully charged	25 4 volts or above
Battery half charged	24 6 to 25 4 volts
Battery fully discharged	23 7 volts or below

NOTE

The above readings are most reliable if the batteries have stood for at least 8 hours without charge or discharge

Battery condition meter (engine running about 1500 rpm and no electrical load)	
Battery near to fully charged	27 0 to 28 0 volts
Battery partially discharged	24 0 to 27 0 volts
Battery charge low	Below 24 0 volts
Battery condition meter (normal operation)	
Above 24 volts	Alternator output matching or greater than electrical load
Below 24 volts	Load in excess of alternator output
Opening temperature range for thermostat	160° - 170°F

NOMENCLATURE

Boat, Bridge Erection,
Twin Jet, Aluminum
Hull

HULL

Manufacturer

MK1

Allday Aluminum
Limited, Gosport
Hampshire PO12 4DT
England

MK2

American Development
Corporation (ADCOR)
1930 Hanahan Road
North Charleston, SC
29406

Length (overall)
Width (overall)
Height (with cab)
Height (without cab)
Weight
Construction

322.8 inches (820 cm)
98 inches (249 cm)
109.8 inches (279 cm)
77.9 inches (198 cm)
8800 lbs (4000 kg)
Welded aluminum

ENGINE

Manufacturer

Sabre Engines Ltd
Ferndown Industrial
Estate, Wimborne
Dorset, England
212

Model

Maximum rpm (no load)

MK1

MK2

Shaft horsepower

Weight (dry)

No of cylinders

Bore

Stroke

Total displacement

Rotation

Firing order

Compression ratio

Compression pressure (min)

Valve clearance (hot)

No of main bearings

Upper main bearings

Lower main bearings

Oil pump

2800 rpm
2900 rpm
212 @ 2500 rpm \pm 50
1358 lbs (with trans-
mission) (616 kg)
6
4 125 inches (105 mm)
4 524 inches (115 mm)
363 cubic inches
(5 95 liters)
Counterclockwise (as
viewed from fly-
wheel)
1, 5, 3, 6, 2, 4
14 7 to 1
300 psig
0 018 inch
7
Grooved, oil feed
holes, steel backed
aluminum tin liners
Groove in center and
rear liners only,
steel backed alumi-
num tin liners
Sliding vane type
camshaft driven

Idle speed	650 to 750 rpm
Fresh water capacity	
MK1	7-1/5 gallons (27 liters)
MK2	18 gallons (68.1 liters)
Lubricating oil capacity	17-1/2 quarts (16.4 liters)
Injection pump timing	21° BTDC
Diesel fuel specification	VV-F-800
Lubrication specification	MIL-M-2104

FUEL INJECTOR

Manufacturer	CAV Limited, P.O. Box 36 Warple Way, London, England
Model	49053
Nozzle setting pressure	2999 psig (205 atms)

ALTERNATOR

Manufacturer	CAV Limited, P O Box 36 Warple Way, London, England
Model	AC 5
Type	Three-phase, stationary field, revolving armature, self-limiting in current output, current output 17A at 2000 rpm, 22A at 3000 rpm

STARTER MOTOR

Manufacturer	CAV Limited, P O Box 36 Warple Way, London, England
Model	CA45

HYDRAULIC MARINE GEAR (TRANSMISSION)

Manufacturer	Warner Gear Division Borg Warner Corp Muncie, Indiana 47302
--------------	--

Model	10-18-002
Type	Hydraulically clutched forward- reverse trans- mission
Rotation	Counterclockwise
Forward-reverse selection	Hydraulic fluid direction to clutches by selec- tor valve inside transmission
Front oil pump	Positive displacement gear type (driven at engine speed)
Oil type	Engine oil
Oil pressure (normal)	110.0 to 150.0 pounds per square inch (7.7 to 10.5 Kp/cm ²)
Oil pressure (maximum)	250 0 pounds per square inch ₂ (17.5 Kp/cm ²)
Oil temperature (normal)	155° to 165° Fahrenheit (68 3 to 73.8°C)
Regulator valve spring weight	98 to 108 pounds at 1-1/16 inch height (44 5 to 49 1 Kg at 2 7 cm)

STEERING PROPULSION SYSTEM

Manufacturer	Dowty Hydraulic Units Limited
Type	Cheltenham, England Hydrojet, 12 inch (300 mm) diameter, two stage with scoops for reversing water flow and nozzles that swing through an angle of 40 degrees either side of central position for steering
Steering	Through cable control from helm in front cockpit to steering assembly portion of the hydrojet unit

ELECTRICAL SYSTEM (24 Volts Direct Current)

Batteries
Voltage
Number
Connection

12
 4

Two batteries are connected in series to give 24-volt output, one pair is used to provide starting power and the second pair to provide all light and bilge pump operation power

ACCESSORIES

Electric bilge pumps
Manufacturer

EMPO Pump Co , Inc.
 Piqua, Ohio
 32-30

Model
Type

Heavy-duty enclosed motor-driven impeller

Discharge venting

Forward pump discharges through vent in transom onto diver's platform

Manual bilge pump
Manufacturer

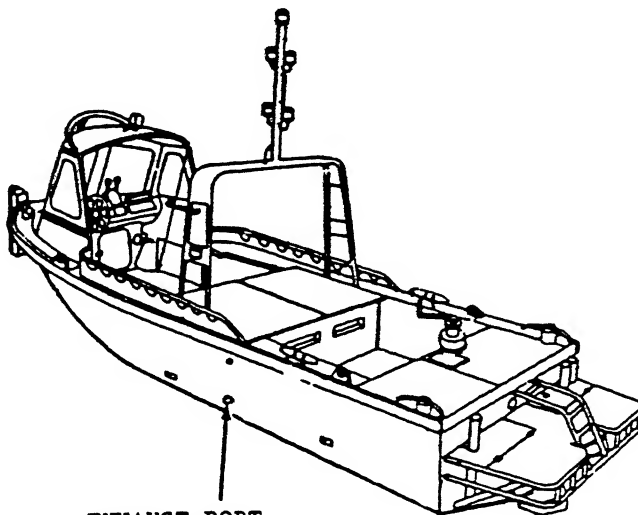
Henderson Pumps and Equipment Ltd
 38 Medina Road,
 Cowes, Isle of Wight, PO 31, 7BZ, England

Model
Type

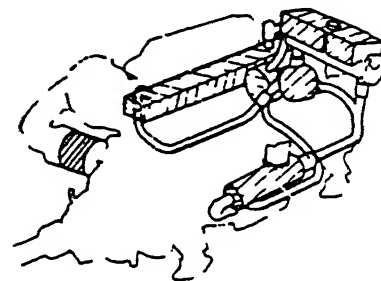
Mk V
 Hand-operated diaphragm pump

1-8.1 DIFFERENCES BETWEEN MODELS. There are two models of the Bridge Erection Boat, the MK1 and the MK2. The two models have different engine cooling systems and air-exhaust systems. The MK2 also has several additional features not on the MK1.

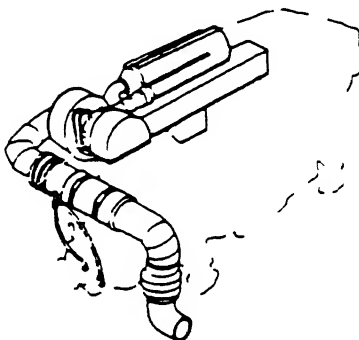
- a. MK1. The MK1 uses two cooling systems, one closed system using fresh water and one open system using raw water, to cool each engine. Raw water from the raw water cooling system cools the exhaust system. The exhaust system expels exhaust gas and raw water through ports located to port of the port engine and to starboard of the starboard engine.



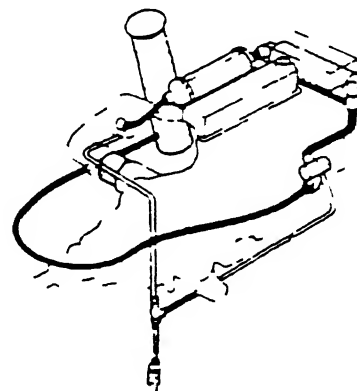
EXHAUST PORT



CLOSED COOLING SYSTEM
(FRESH WATER)

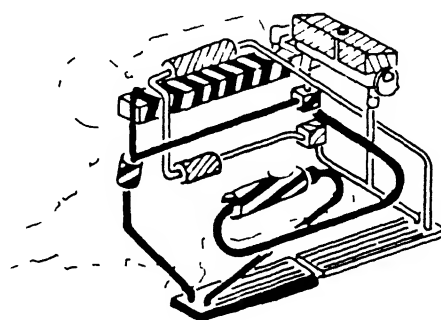
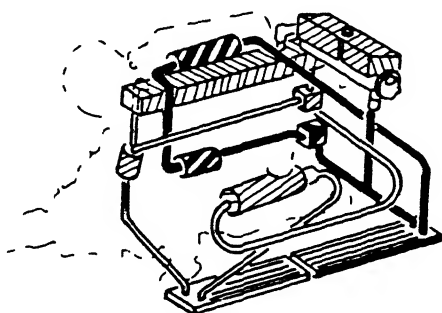
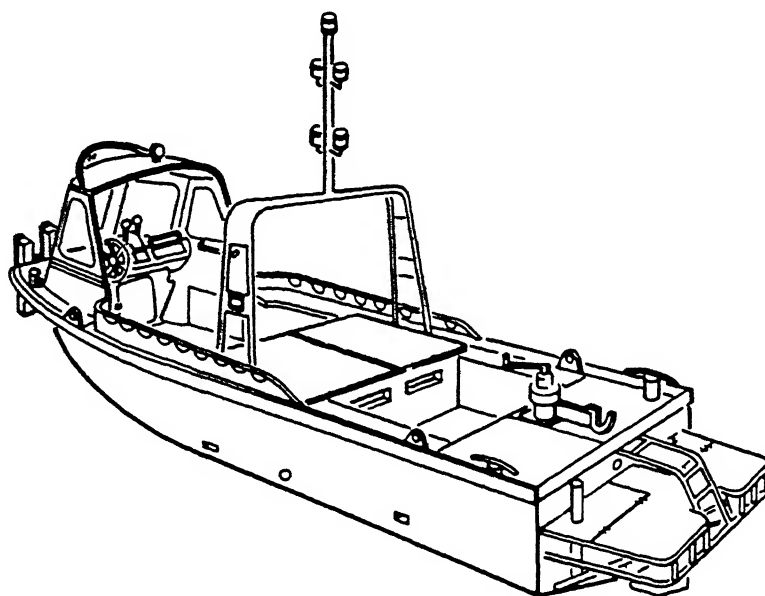


WET EXHAUST SYSTEM



OPEN COOLING SYSTEM
(RAW WATER)

- b. MK2. Each MK2 engine uses two closed cooling systems which share a common reservoir. The MK2 uses a wet exhaust system similar to the MK1. The hydrojet forces raw water into the exhaust system and out the exhaust port on the side of the boat.



CLOSED COOLING SYSTEMS
(FRESH WATER)

CHAPTER 2

DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

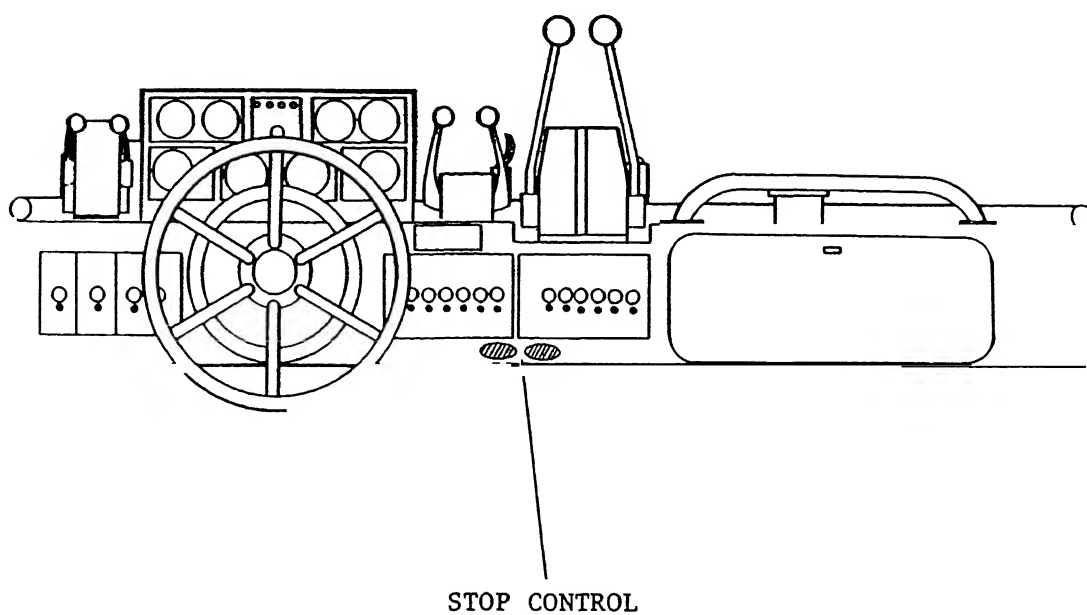
Section I REPAIR PARTS, SPECIAL TOOLS, TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE), AND SUPPORT EQUIPMENT

- 2-1 COMMON TOOLS AND EQUIPMENT. For authorized common tools and equipment refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit
- 2-2 SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT. Special tools and test equipment are required to perform direct and general support maintenance on selected components of the bridge erection boat. The special tools are listed in the Maintenance Allocation Chart (MAC) contained in TM 5-1940-277-20 and in Repair Parts and Special Tools List TM 5-1940-277-34P. Those specially designed tools required for the boat are listed in Appendix C of this publication. These items must be fabricated by the maintenance facility requiring their use. The data required for fabrication are contained in Appendix C of this publication. All specially designed tools required for Direct and General Support Maintenance are applicable to maintenance of the transmission
- 2-3 REPAIR PARTS. Repair parts are listed and illustrated in the Repair Parts and Special Tools List (TM 5-1940-277-34P) covering the direct and general support maintenance for the bridge erection boat

Section II TROUBLESHOOTING PROCEDURES

- 2-4 INTRODUCTION TO TROUBLESHOOTING. This section contains information useful in diagnosing and correcting unsatisfactory operation or failure of the bridge erection boat. Malfunctions which might occur are listed followed by probable causes of the malfunction. The corrective action recommended for the probable cause is described. You should perform the tests, inspections and corrective actions in the order listed. You may be directed to perform appropriate TROUBLESHOOTING TESTS. This will aid you in locating a particular malfunction. This manual cannot list all malfunctions that may occur, nor all tests, inspections or corrective actions possible. If a malfunction is not listed or is not corrected by listed corrective actions consult your supervisor.

TROUBLESHOOTING PROCEDURES (continued)



ROOTING PROCEDURES (Continued)

ION

EST OR INSPECTION

CORRECTIVE ACTION

IN LOSS OF POWER WITH NO BLACK SMOKE

tep 1. Check that stop control lever is at full RUN position.

a. Adjust stop control cable (refer to TM 5-1940-277-20).

b. If stop lever properly positioned go to step 2.

tep 2. Visually inspect the nylon fuel lines for kinking, sharp bends or some type of internal or external restriction (refer to TM 5-1940-277-20).

- If no fuel line restrictions are found go to step 3.

tep 3 Check for air in fuel line or leaking fuel line connections (refer to TM 5-1920-277-20).

- If no air or leak in fuel line go to step 4

tep 4 Make sure engine stop control is pulled out Test for fuel lift pump operation (refer to TM 5-1940-277-20)

- If fuel flow satisfactory go to step 4

tep 5 Check for faulty injectors

a Test injectors (refer to page 2-26)

b Repair faulty injectors (refer to page 2-267) If injectors operate properly go to step 6

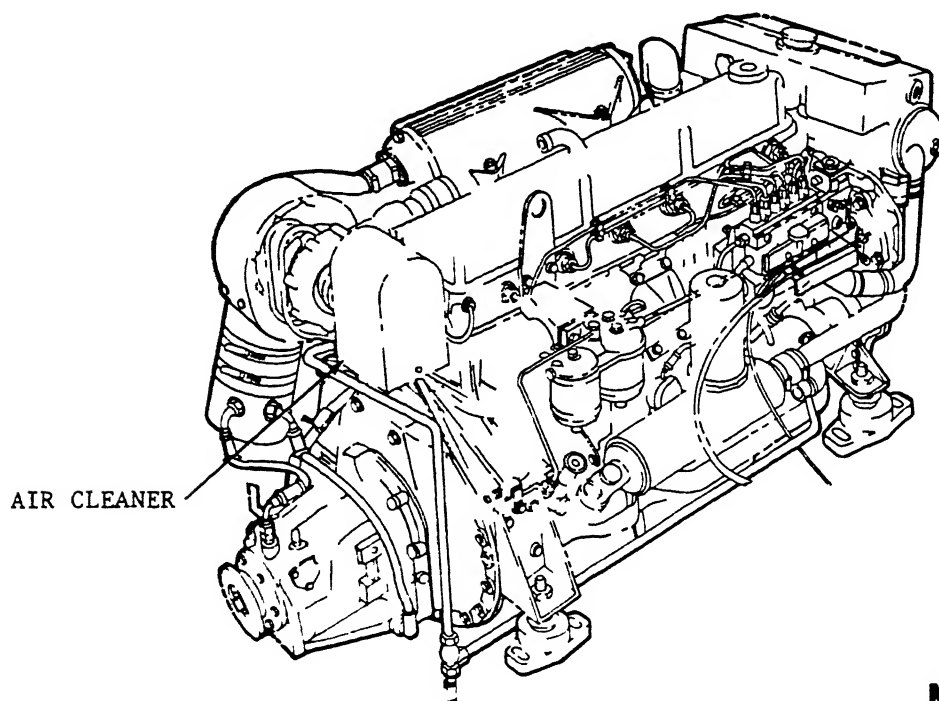
tep 6 Make sure engine stop control is pushed in Test for injector pump operation (refer to TM 5-1940-277-20)

a Replace injection pump (refer to page 2-245)

b. If pump operates correctly contact supervisor

TROUBLESHOOTING PROCEDURES (continued)

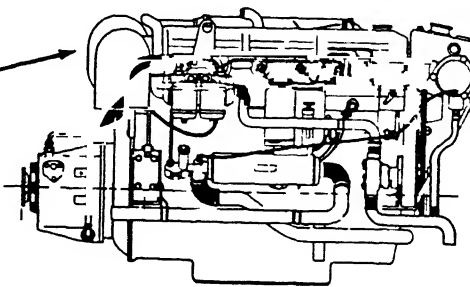
MK1



MK2



AIR CLEANER



TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

2 SUDDEN LOSS OF POWER WITH HEAVY BLACK SMOKE

Step 1. Visually inspect air cleaner for obstruction or clogging
Also inspect air intake slots from aft cockpit to engine compartment
(refer to TM 5-1940-277-20)

- a. Clear any obstructions to air flow. Clean dirty air filter (refer to TM 5-1940-277-20)
- b. Test for faulty turbocharger.
 - 1 Remove air silencer (refer to TM 5-1940-277-20)
 - 2 Check for free rotation of turbine wheel
 - 3 Repair faulty turbocharger (refer to page 5-231)
- c If no air obstructions go to step 2

Step 2 Test for faulty injector (refer to page 2-261)

- a Replace injector (refer to TM 5-1940-277-20)
- b If injector satisfactory contact supervisor

TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

3. ENGINE WILL NOT CRANK

Step 1. Check battery cells specific gravity (refer to TM 5-1940-277-20).

- a Replace battery (refer to TM 5-1940-277-20)
- b If battery check satisfactory go to step 2

Step 2 Check for defective starting switch (refer to TM 5-1940-277-20)

- a Replace defective starting switch (refer to TM 5-1940-277-20)
- b If switch operates correctly go to step 3

Step 3 Check for faulty wiring and connections (refer to page 2-109)

- a Repair faulty wiring (refer to page 2-109)
- b If wiring satisfactory go to step 4

Step 4 Test starter (refer to TM 5-1940-277-20)

- a If voltage not present replace starter solenoid (refer to TM 5-1940-277-20)
- b If voltage present but starter does not function replace starter (refer to TM 5-1940-277-20)

Step 5 Check for hydrostatic lock

- a Attempt to hand crank engine
- b If engine will not turn over by hand, remove injectors one at a time until locked cylinders are freed (Refer to TM 5-1940-277-20)
- c If engines still will not turn go to step 6

TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

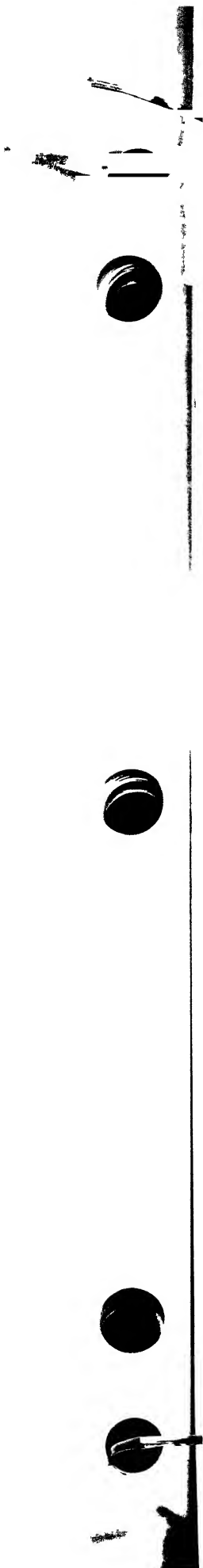
TEST OR INSPECTION

CORRECTIVE ACTION

3. ENGINE WILL NOT CRANK (continued)

Step 6 Check for internal engine seizure

- a Attempt to hand crank engine
- b If engine cannot be rotated through a complete revolution, internal damage is indicated
- c Report problem to General Support



SHOOTING PROCEDURES (Continued)

TION

TEST OR INSPECTION

CORRECTIVE ACTION

WHEN RUNNING OR FREQUENT STALLING

Step 1. Check for air in fuel line or leaking fuel line connections

- a. If leaks or air present refer to TM 5-1940-277-20
- b. If no air or leak in fuel line go to step 2

Step 2 Test for defective fuel lift pump (refer to TM 5-1940-277-20)

- a. Replace fuel lift pump (refer to TM 5-1940-277-20)
- b. If fuel lift pump all right go to step 3

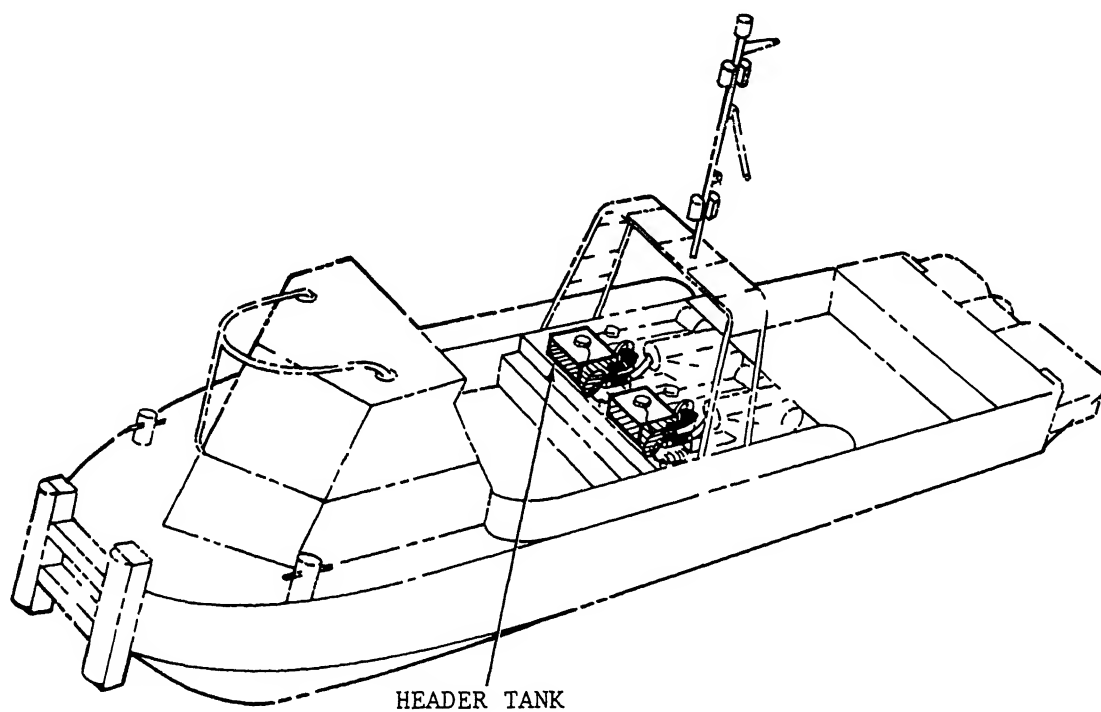
Step 3 Test for faulty injector (refer to page 2-261)

- a. Replace injector if defective (refer to TM 5-1940-277-20)
- b. If symptoms continue go to Step 4

Step 4 Perform compression test to determine if valves or piston rings are defective (refer to page 2-173)

- a. If valves are defective replace or repair as required (refer to page 2-277)
- b. If piston rings are defective report to General Support
- c. If compression check is all right contact supervisor

TROUBLESHOOTING PROCEDURES (continued)



TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

5. EXCESSIVE CRANKCASE PRESSURE (OIL COLLECTING IN BREATHER SEDIMENTER BOWL OR BEING BLOWN OVERBOARD)

Step 1. Check for obstruction in exhaust pipe by using hand and feeling exhaust output for each engine.

a. If exhaust output appears restricted remove the exhaust flexible bellows and check exhaust pipes for obstructions (refer to TM 5-1940-277-20).

b. If no obstruction is evident go to step 2

Step 2 Remove header tank cap Start engine and observe water in tank for continual bubbling as evidence of leaking head gasket

a Replace head gasket (refer to page 2-291)

b Change engine oil (refer to TM 5-1940-277-20)

c If no evidence of head gasket failure found contact supervisor

WARNING

Cap under pressure when water hot Remove carefully
Severe burns may result

Step 3 Perform cylinder compression test to determine where blow-by is occurring (refer to page 2-173)

a Report broken or worn piston rings, piston or sleeve to General Support

TROUBLESHOOTING

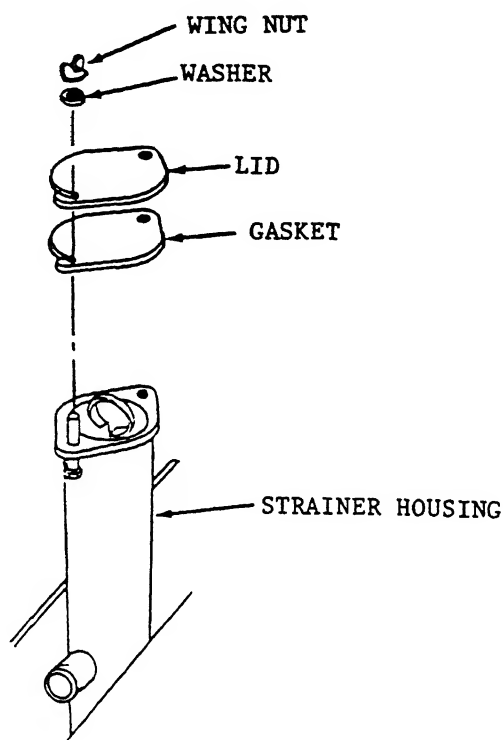
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

6. ENGINE OVERHEATS (ENGINE AUDIBLE ALARM ACTIVATES)

a. MK1



Step 1 Stop engine and turn engine circuit switch OFF

Step 2 Check for washer under intake strainer housing lid rather than on top

a If washer is present, remove and discard

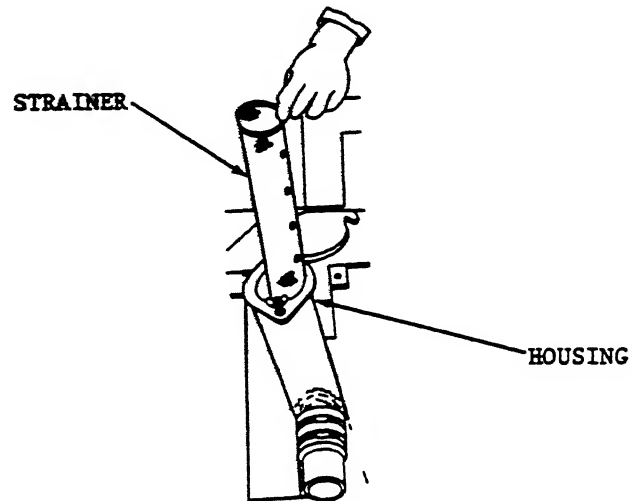
TROUBLESHOOTING (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

6. ENGINE OVERHEATS (ENGINE AUDIBLE ALARM ACTIVATES) (Continued)

a MK1

Step 3 Check raw water intake

- a Clean strainer and housing
- b Replace strainer (refer to TM 5-1940-277-20)

Step 4 Inspect raw water pump impeller, cam, and end plate (refer to TM 5-1940-277-20)

- a Replace defective impeller
- b Replace defective cam
- c Replace end plate
- d Replace raw water pump (refer to TM 5-1940-277-20)

TROUBLESHOOTING (Continued)

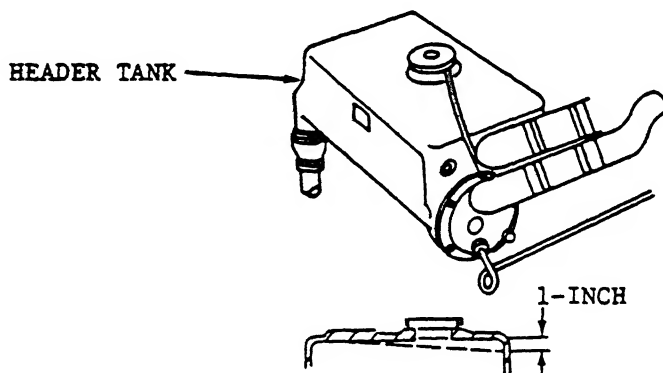
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

6. ENGINE OVERHEATS (ENGINE AUDIBLE ALARM ACTIVATES) (Continued)

a. MK1



Step 5 Check coolant level in header tank

a Fill to 1" below neck

Step 6 Check for leaks in fresh water system

a Tighten hose clamps

b Replace defective hoses (refer to TM 5-1940-277-20)

c Repair header tank (refer to TM 5-1940-277-20)

d Replace header tank (refer to TM 5-1940-277-20)

Step 7 Check raw water hoses and fittings (refer to TM 5-1940-2

a Tighten hose clamps

b Replace defective hoses and fittings (refer to TM 5-1940-277-20)

TROUBLESHOOTING (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

6 ENGINE OVERHEATS (ENGINE AUDIBLE ALARM ACTIVATES) (Continued)

a. MK1

Step 8. Check V-belt for looseness, breaks, or fraying.

a. Adjust to correct tension (refer to TM 5-1940-277-20).

b. Replace V-belt (refer to TM 5-1940-277-20)

Step 9. Check thermostat (refer to TM 5-1940-277-20)

a. Replace thermostat (refer to TM 5-1940-277-20) Do not
operate engine without thermostat installed.

Step 10 Check fresh water pump for leaks.

a. Replace defective fresh water pump (refer to TM 5-
1940-277-20)

Step 11 Check intercooler for loose connections or leaks

a Tighten loose raw water hose clamps

Step 12 Check water temperature sending unit

a Replace defective water temperature sending unit (refer
to TM 5-1940-277-20)

Step 13 Check for clogged heat exchanger by removing
and inspecting (refer to TM 5-1940-277-20)

a Replace defective heat exchanger (refer to
TM 5-1940-277-20)

TROUBLESHOOTING (Continued)

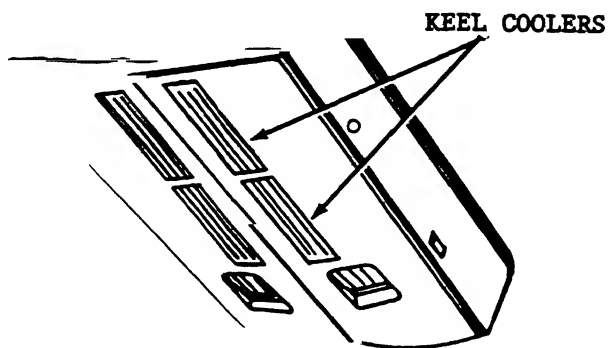
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

6. ENGINE OVERHEATS (ENGINE AUDIBLE ALARM ACTIVATES) (Continued)

b. MK2



- Step 1 Stop engine and turn engine circuit switch OFF
- Step 2 Check keel cooler for marine growth and other foreign matter. Also check for leaks, or any sign of corrosion
- a Clean keel coolers with metal brush.
 - b Replace keel cooler (refer to TM 5-1940-277-20)

TROUBLESHOOTING (Continued)

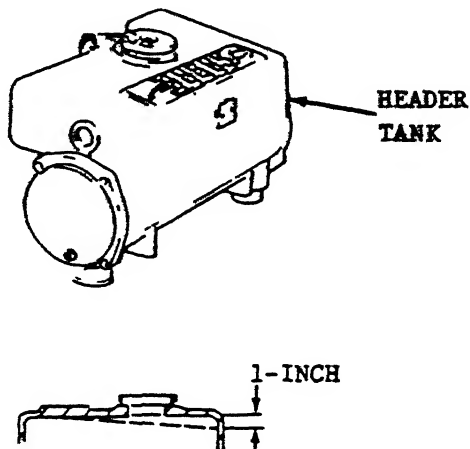
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

6. ENGINE OVERHEATS (ENGINE AUDIBLE ALARM ACTIVATES) (Continued)

b MK2



Step 3 Check coolant level in header tank

a Fill to 1" below neck

Step 4 Check for leaks in secondary cooling system

a Tighten hose clamps

b Replace defective hoses (refer to TM 5-1940-277-20)

c Replace header tank (refer to TM 5-1940-277-20)

Step 5 Inspect secondary water pump impeller, cam, and end plate (refer to TM 5-1940-277-20)

a Replace defective impeller

b Replace defective cam

c Replace end plate

d Replace secondary water pump (refer to TM 5-1940-277-20)

TROUBLESHOOTING (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

6 ENGINE OVERHEATS (ENGINE AUDIBLE ALARM ACTIVATES) (Continued)

b MK2

Step 6. Test water temperature sending unit (refer to TM 5-1940-277-20)

- a. Replace defective water temperature sending unit (refer to TM 5-1940-277-20)**

Step 7. Check V-belt for looseness, breaks, or fraying.

- a. Adjust to correct tension (refer to TM 5-1940-277-20)**
- b. Replace V-belt (refer to TM 5-1940-277-20)**

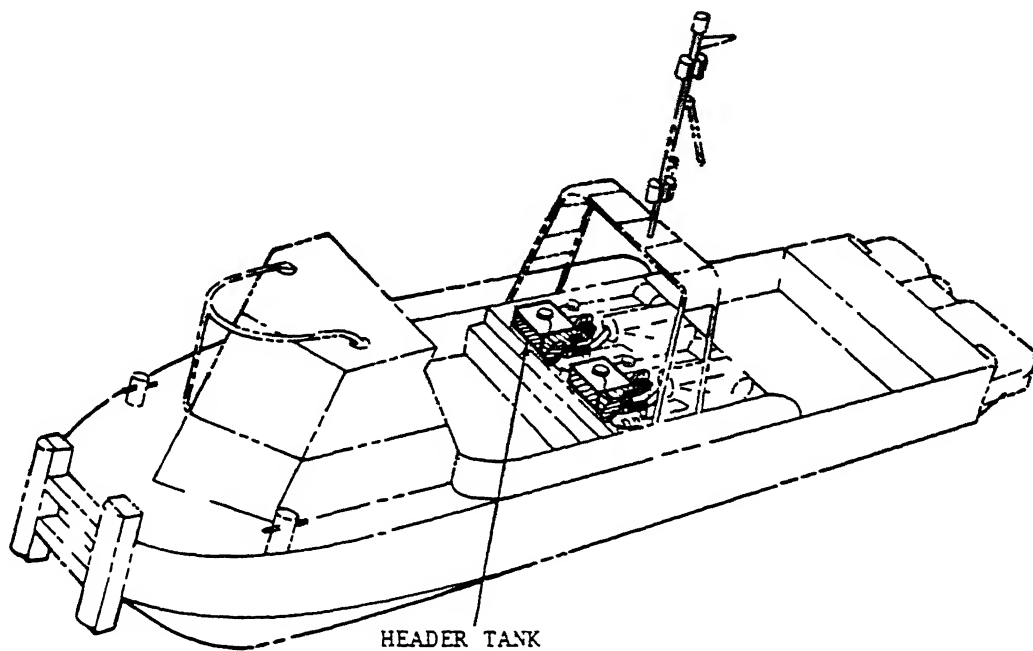
Step 8 Check primary cooling system for leaks

- a Tighten hose clamps (refer to TM 5-1940-277-20)**
- b Replace defective hoses (refer to TM 5-1940-277-20)**

Step 9 Check primary water pump for leaks

- a Replace defective primary water pump (refer to TM 5-1940-277-20)**
- b Replace thermostat (refer to TM 5-1940-277-20) Do not operate engine without thermostat installed**

TROUBLESHOOTING (Continued)



All data on page 2-12 deleted

ESHOOTING PROCEDURES (Continued)

CTION

TEST OR INSPECTION

CORRECTIVE ACTION

SS OF LUBRICATION OIL PRESSURE (SUDDEN DROP OF PRESSURE)

Step 1. Check sending units and gauges (refer to TM 5-1940-277-20)

a. If sending unit and gauges operating go to step 2

Step 2 Check engine oil level (refer to TM 5-1940-277-10)

- If oil level correct go to step 3

Check sending units and guages.

WARNING

Cap under pressure when water hot Remove carefully
Severe burns may result

Step 3 Remove header tank cap Check fresh water for oil film
contamination Contamination indicates cracked engine oil cooler tube
stack (refer to TM 5-1940-277-20)

a Replace oil cooler (refer to TM 5-1940-277-20)

b If no contamination go to step 4

Step 4 Check for defective oil pump

a Replace defective oil pump (refer to page 3-9)

b If oil pump all right contact supervisor

TROUBLESHOOTING (Continued)

WATER PUMP FUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

6. ENGINE OVERHEATS (ENGINE AUDIBLE ALARM ACTIVATES) (Continued)

b. MK2

Step 6. Test water temperature sending unit (refer to TM 5-1940-277-20)

- a. Replace defective water temperature sending unit (refer to TM 5-1940-277-20).

Step 7. Check V-belt for looseness, breaks, or fraying.

- a Adjust to correct tension (refer to TM 5-1940-277-20)
- b Replace V-belt (refer to TM 5-1940-277-20)

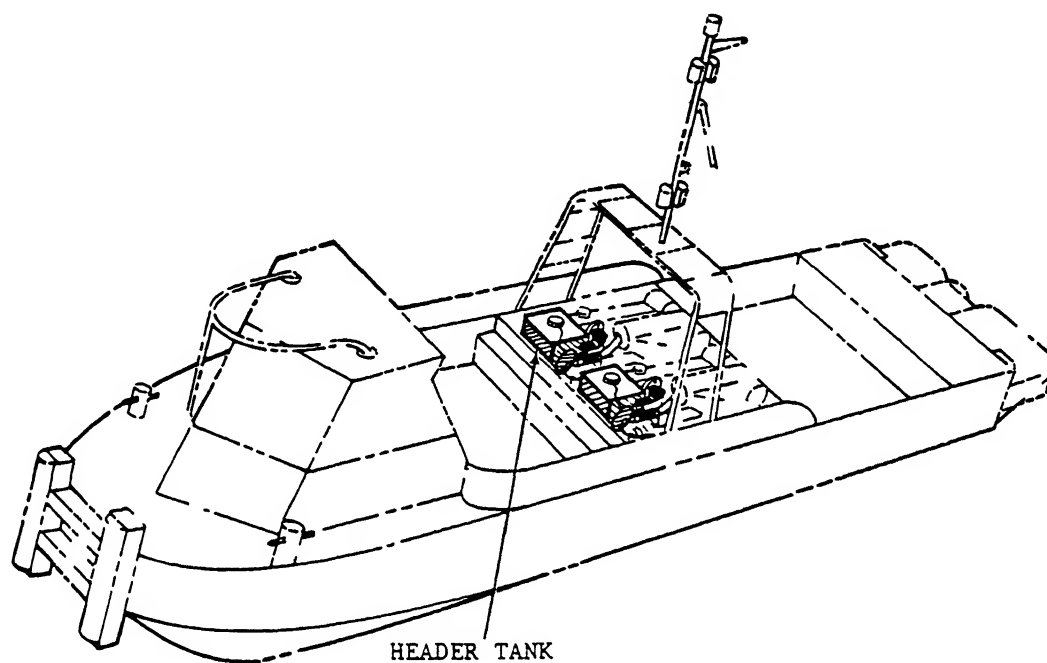
Step 8 Check primary cooling system for leaks.

- a. Tighten hose clamps (refer to TM 5-1940-277-20)
- b Replace defective hoses (refer to TM 5-1940-277-20)

Step 9 Check primary water pump for leaks

- a Replace defective primary water pump (refer to TM 5-1940-277-20)
- b Replace thermostat (refer to TM 5-1940-277-20) Do not operate engine without thermostat installed.

TROUBLESHOOTING (Continued)



All data on page 2-12 deleted



TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

7. LOSS OF LUBRICATION OIL PRESSURE (SUDDEN DROP OF PRESSURE)

Step 1. Check sending units and gauges (refer to TM 5-1940-277-20)

a If sending unit and gauges operating go to step 2

Step 2 Check engine oil level (refer to TM 5-1940-277-10)

- If oil level correct go to step 3

Check sending units and gauges

WARNING

Cap under pressure when water hot Remove carefully
Severe burns may result

Step 3 Remove header tank cap Check fresh water for oil film
contamination Contamination indicates cracked engine oil cooler tube
stack (refer to TM 5-1940-277-20)

a Replace oil cooler (refer to TM 5-1940-277-20)

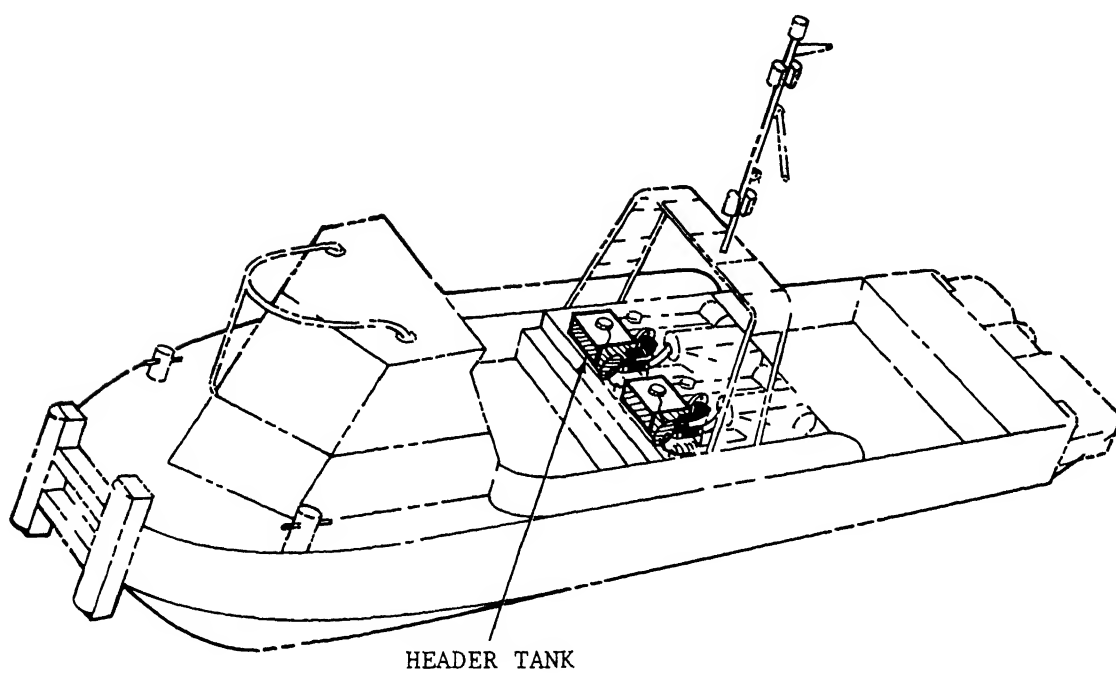
b If no contamination go to step 4

Step 4 Check for defective oil pump

a Replace defective oil pump (refer to page 3-9)

b If oil pump all right contact supervisor

TROUBLESHOOTING PROCEDURES (continued)



TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

8. HIGH LUBRICATING OIL CONSUMPTION

Step 1. Check for oil in bilge or on engine as evidence of leaking gasket or seal.

- a. Replace gasket or seal found to be source of leak
- b. If no leak evident go to step 2.

WARNING

Cap under pressure when water hot Remove carefully
Severe burns may result

Step 2 Remove cap from header tank Check fresh water for oil film contamination as evidence of engine oil cooler leaking

- a. Replace engine oil cooler (refer to TM 5-1940-277-20)
- b. If no evidence of oil cooler leakage go to step 4

Step 3 Check for excessive crankcase pressure

- a. Inspect engine breather hose and trap for excessive oil, an indication of excessive crankcase pressure
- b. Excessive crankcase pressure is evidence of faulty piston rings or head gasket

1. Replace faulty cylinder head gasket (refer to page 2-291)

2. Refer faulty piston rings to General Support

Step 4 Perform compression tests to determine if valves or piston rings are defective (refer to page 2-173)

- a. Repair or replace valve guides and/or valves as required (refer to page 2-277)
- b. Report defective piston rings to General Support
- c. If compression satisfactory contact supervisor.

TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

9 TRANSMISSION MALFUNCTIONS

CAUTION

Boat must be in water to run engine For exception during organizational or higher maintenance actions, refer to page 3-326, TM 5-1940-277-20

Step 1. Start engine and let run for 2 minutes with transmission in neutral Shut engine off and wait 5 minutes and then check oil level Must be to mark on dipstick

a Fill with fluid to proper level (refer to TM 5-1940-277-10)

b Fluid level all right go to step 2

Step 2 Check for improperly adjusted control linkage (refer to TM 5-1940-277-20)

- If linkage adjustment is correct go to step 3

Step 3 Test for low oil pressure with transmission in neutral (refer to page 2-21)

a Clean oil strainer (refer to TM 5-1940-277-20)

b Clean pressure regulator valve (refer to page 2-327)

c Check for weak pressure regulator spring

d Replace defective oil pump (refer to page 2-237)

e If pressure all right contact supervisor

Step 4. Test transmission in forward position

- Report defective transmission to General Support

TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

10. TRANSMISSION HAS GEAR NOISE IN FORWARD OR REVERSE

Step 1. Check for inadequate torque on output shaft nut

a. Torque nut to 140-150 ft lbs If nut will not torque report to General Support.

b. If nut properly torqued report to General Support

Step 2 Check for loose transmission mounting bolts (refer to page 2-349)

a. If nut will not torque report to General Support

b If bolt properly torqued go to step 3

Step 3 Check for worn or defective flywheel damper (refer to page 2-317)

a Replace defective or worn flywheel damper (refer to page 2-317)

b If flywheel damper is all right report to General Support

TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

11 TRANSMISSION SHIFTS HARD

Step 1 Check transmission shift control linkage for obstructions or improper adjustment (refer to TM 5-1940-277-20)

a. Check for broken poppet spring or excessively worn (scored) detent ball (refer to step J on page 2-336)

b Clean pressure regulator valve (refer to page 2-327)

Step 2 Check for damaged "O" ring on transmission selection valve which pressure regulator is removed

a If pressure regulator and "O" ring are all right contact supervisor

TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

12. STEERING SYSTEM FEELS LOOSE

Step 1. Check for loose or improperly adjusted steering cables and linkage (refer to TM 5-1940-277-20).

Step 2. Check for worn bushings and bearings (refer to page 2-409).

Step 3. If bushings or bearings are all right and adjusted correctly contact supervisor

13. SCOOP CONTROLS ARE HARD TO OPERATE

Step 1 Check steering assembly brush for wear (refer to TM 5-1940-277-20)

Step 2 Check control cables for damage (refer to TM 5-1940-277-20)

Step 3 Check rotary control assembly for defective bearings (refer to page 2-409)

Step 4 If controls still hard to operate contact supervisor

TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

11 TRANSMISSION SHIFTS HARD

Step 1. Check transmission shift control linkage for obstructions or improper adjustment (refer to TM 5-1940-277-20)

a Check for broken poppet spring or excessively worn (scored) detent ball (refer to step J on page 2-336)

b Clean pressure regulator valve (refer to page 2-327)

Step 2 Check for damaged "O" ring on transmission selection valve which pressure regulator is removed

a If pressure regulator and "O" ring are all right contact supervisor

TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

12. STEERING SYSTEM FEELS LOOSE

Step 1. Check for loose or improperly adjusted steering cables and linkage (refer to TM 5-1940-277-20).

Step 2. Check for worn bushings and bearings (refer to page 2-409).

Step 3. If bushings or bearings are all right and adjusted correctly contact supervisor

13. SCOOP CONTROLS ARE HARD TO OPERATE

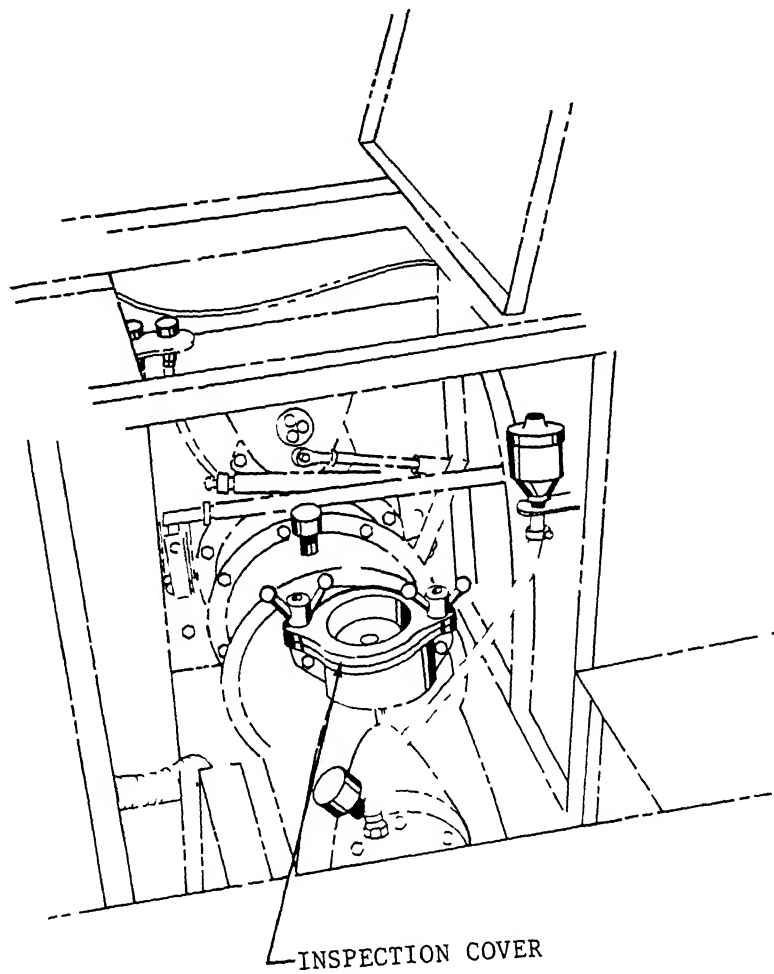
Step 1 Check steering assembly brush for wear (refer to TM 5-1940-277-20)

Step 2 Check control cables for damage (refer to TM 5-1940-277-20)

Step 3 Check rotary control assembly for defective bearings (refer to page 2-409)

Step 4 If controls still hard to operate contact supervisor

TROUBLESHOOTING PROCEDURES
(Continued)



TROUBLESHOOTING PROCEDURES (Continued)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

14. BOAT VIBRATES WHILE UNDER WAY

NOTE

Boat must be out of water on cradle or on hardstand for test or inspection

Step 1. One person in boat will open the hydrojet compartment hatch covers and remove the intake case inspection covers. Then reach into the hydrojet unit and feel the front impeller for evidence of deformation or damage. After this inspection a second person using a strong light should look through the jet nozzle at the rear impeller while the first person slowly rotates the unit grasping either the shaft or coupling. Damage will most probably occur to the front impeller.

a If damaged impellers report to General Support

b If impellers all right contact supervisor

Step 2 Check for loose engine mounting bolts (refer to page 2-161)

5

1

1

1

TROUBLESHOOTING TEST FOR TRANSMISSION

This task covers.

a Test

INITIAL SETUP

Test Equipment

Hydraulic pressure gage (130 psi min.)

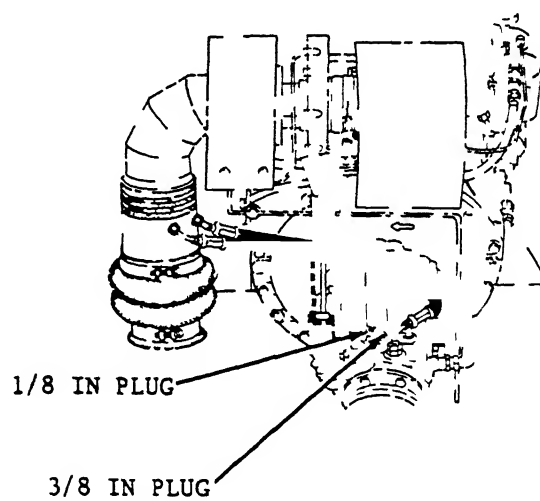
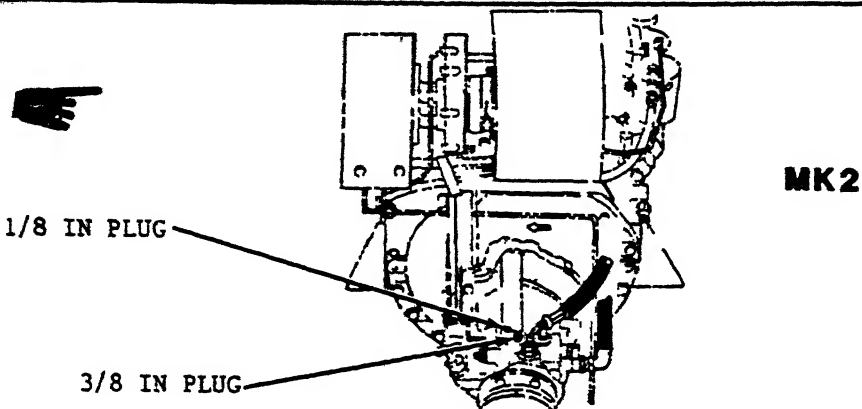
3/8 in pipe plug connection

1/8 in pipe plug connection

13/64 in hex key wrench

5/16 in hex key wrench

TROUBLESHOOTING TEST FOR TRANSMISSION
(continued)



TROUBLESHOOTING TEST FOR TRANSMISSION
(Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

NOTE

Operate transmission in reverse for only 10 - 15 seconds at a time.

- | | | | |
|----|--|--|--|
| 10 | Start engine | | |
| 11 | Shift transmission to reverse and check pressure readings as per chart
Low pressure readings in reverse indicate same possible problems as
neutral low pressure readings | | |
| 12 | High pressure in any range indicate sticking regulator valve, wrong or
cold oil | | |
| 13 | Using 13/64 in hex key wrench, disconnect hydraulic pressure gage and
install 1/8" pipe plug | | |

1

Section III. DIRECT SUPPORT MAINTENANCE PROCEDURES

GENERAL. This section covers general information for disassembly, cleaning, inspection, repair and assembly for component parts of the bridge erection boat. Specific instructions for individual component maintenance are covered in the appropriate sections.

DISASSEMBLY. Related parts must be kept together, preferably in a tray, to prevent their being lost. For those components which have too many or too large parts to use trays, tag parts with their name as they are disassembled. This will make it easier to identify parts when reassembling the components. Precision matched or mated parts will be marked to insure reassembly in the proper position and place.

CLEANING. All parts except bearings are to be cleaned as specified in TM 9-247. Bearings should be cleaned as specified in TM 9-214.

INSPECTION.

- a. **General.** The importance of carefully inspecting disassembled parts cannot be stressed enough. Reassembly of substandard or defective parts can result in needless troubleshooting, disassembly and inspection. Inspection procedures must be performed by experienced personnel using proper tools and equipment. All measuring and testing equipment must be checked periodically and when required accurately calibrated in accordance with current directives. The recording of complete and accurate inspection records as specified in DA Pam 738-750 is a necessary part of all inspection actions.
- b. **Metallic Parts.** The following procedures should be followed when inspecting metallic parts:
 - (1) Inspect all parts for cracks
 - (2) Inspect gear teeth, retaining ring grooves and mating surfaces for burrs
 - (3) Inspect mating and polished surfaces for nicks, scratches and rust. Any nick, scratch, or rust is cause for rejection
 - (4) Inspect short metal parts for bends, cracks, tears, broken corners or defective welds
- c. **Non-Metallic Parts.** Non-metallic parts such as seals and gaskets are not subject to inspection. They will be disposed of upon removal and replaced by new items during reassembly.

REPAIR

- a. Hull parts that are cracked may be repaired by welding if it does not distort or impair the strength of the part. Welding procedures will be accomplished as specified in TM 9-237.
- b. A fine file or hone may be used to remove small burrs from gear teeth, retaining ring grooves and mating surfaces. The burrs must be very minor and if on gears only on the engaging edge of the teeth.
- c. Damaged painted surfaces should be repainted as soon as possible to prevent corrosion.

ASSEMBLY. Step-by-step procedures for assembly of the bridge boat components are provided in Chapters 2 and 3. In addition observe the following practices:

- a. Coat the housing contact surface of oil seals with a non-hardening sealer to prevent damage. The lips should be coated with grease (GAA).
- b. All pressing operations should be accomplished using a suitable press and adapters unless otherwise specified.
- c. Metallic parts should be lubricated with the lubricant utilized the component during operation.
- d. Critical torque values are specified in the assembly procedures.
- e. Silicone sealant is used on gaskets and mating surfaces in the engine assembly.

GENERAL DETAILED PROCEDURE APPLICATIONS

- a. Resources required are not listed unless they apply to the procedure.
- b. Personnel required are listed only if the task requires more than one. If PERSONNEL are not listed it means that one person can do the task
- c. The normal standard equipment condition to start a maintenance task is power (MASTER SWITCH) OFF. EQUIPMENT CONDITION is not listed unless some other condition is required besides the (MASTER SWITCH) being OFF.

NOTE

Remember the bridge erection boat has two water cooling systems (refer to FO-3)

- d. The MK1 engine WILL NOT be operated without a supply of water to circulate through the raw water system. At full speed the system requires 27 gallons of water per minute. The MK2 engine WILL NOT be operated out of water for more than 20 minutes at idle speed. Any maintenance task step that requires engine operation MUST BE performed with the boat in water or by following Out of Water Engine Operation procedures (TM 5-1940-277-20)
- e. Standard maintenance procedure requires that upon completion of maintenance action a component function and performance check be conducted to assure no leakage or malfunction exists. If leakage or malfunction is found repeat the maintenance procedure to correct problem
- f. Standard maintenance procedure requires that an operational check be performed after completion of repairs if possible. This step not called out as part of the procedure.

DIRECT SUPPORT MAINTENANCE PROCEDURE INSTRUCTIONS INDEX

Procedure	Page
CAB	
Windshield Wiper Motor Repair	2-31
FUEL SYSTEM	
Fuel Tank Replacement	2-39
COOLING SYSTEM	
Drain Down Valve Replacement (MK1)	2-51
ELECTRICAL SYSTEM	
Alternator Repair	2-57
Interconnecting Loom (Engine Wiring Harness) Replacement	2-93
Interconnecting Loom (Engine Wiring Harness) Repair	2-109
Engine Wiring Interconnect Harness Replacement	2-115
Mast Loom (Mast Wiring Harness) Replacement	2-121
Control Box Replacement	2-145
ENGINE	
Engine Mounts and Brackets Replacement	2-161
Engine Assembly Test	2-173
Engine Assembly Replacement	2-179
Starter Motor Repair	2-191
Turbocharger Repair	2-231
Injection Pump Replacement	2-245
Injector Test	2-261
Injector Repair	2-261
Cylinder Head Assembly Inspection	2-277
Cylinder Head Assembly Repair	2-277
Cylinder Head Assembly Replacement	2-291
Valve Spring Replacement	2-301
Oil Sump (Pan) Inspection	2-307
Oil Sump (Pan) Replacement	2-307
Flywheel and Housing Replacement	2-317
TRANSMISSION	
Valve and Spring Assembly Replacement Instructions	2-327
Transmission Oil Pump Replacement	2-337
Transmission Replacement	2-345
HYDROJET UNIT	
Hydrojet Assembly Replacement	2-353
Steering Assembly Replacement	2-367
Reverse Balance Lever Replacement (Steering Assembly Repair Instructions)	2-383
Scoop Control Rod Replacement (Steering Assembly Repair Instructions)	2-391
Scoop Replacement (Steering Assembly Repair Instructions)	2-397
Rotary Control Repair (Steering Assembly Repair Instructions)	2-409
Rotary Control Replacement	2-419
HULL	
Hull Assembly Repair	2-423



WINDSHIELD WIPER MOTOR REPAIR INSTRUCTIONS

This task covers

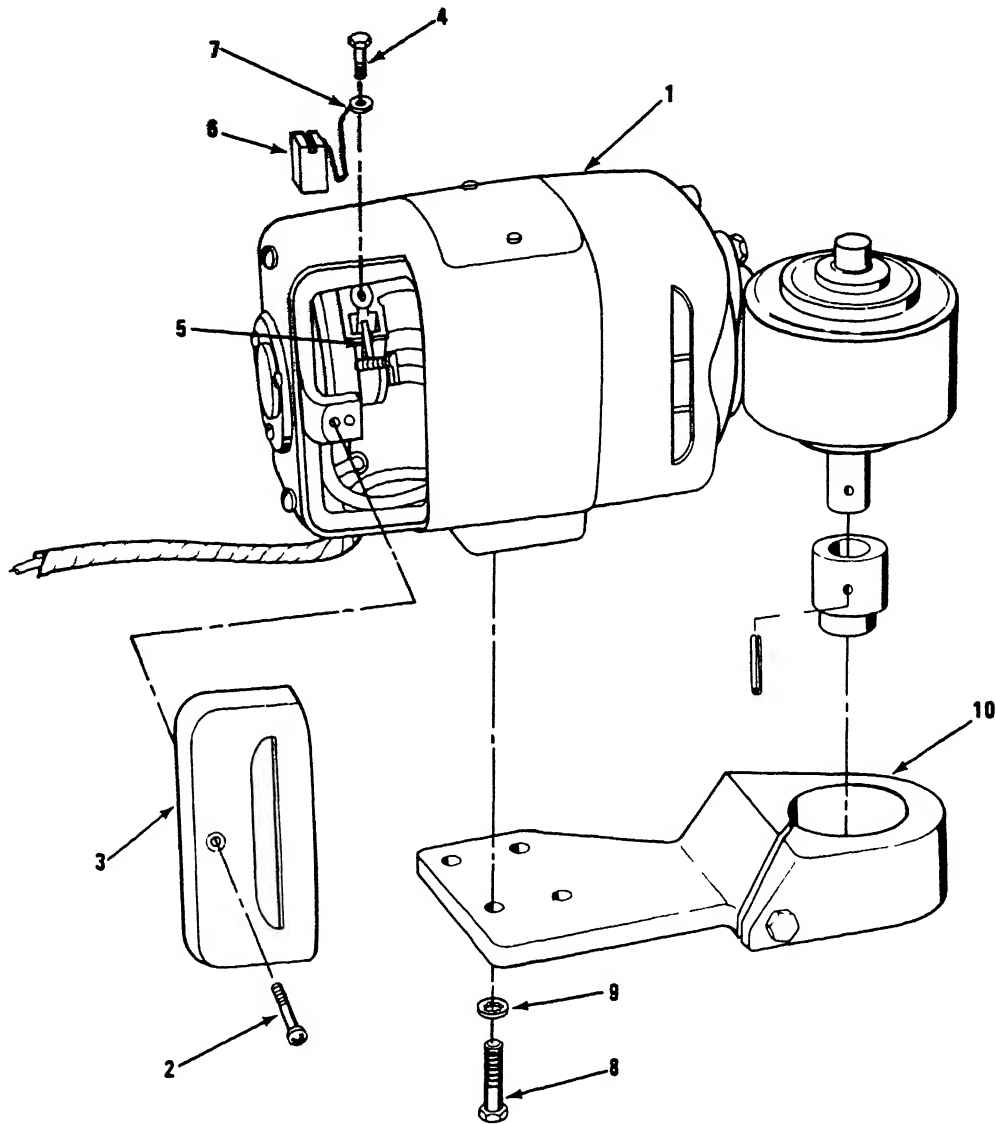
- | | |
|------------------------------------|---|
| a. Disassemble - brush replacement | d. Disassemble - drive coupling replacement |
| b. Cleaning motor | |
| c. Assemble - brush replacement | e. Assemble - drive coupling replacement |

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Needle nose pliers	TM 5-1940-277-20	Windshield wiper motor removed from boat
3/16 in open end wrench		
Cross tip screwdriver		
1/4 in socket, 1/4 in drive		
1/4 in drive ratchet		
3/8 in punch		
Slip joint pliers		
Hammer, ball peen, 8 oz		
Safety goggles		
Air compressor		
Air blow gun		
Materials/Parts		
Two brushes		
Drive coupling		

WINDSHIELD WIPER MOTOR REPAIR INSTRUCTIONS

(Continued)



WINDSHIELD WIPER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>ASSEMBLE - BRUSH REPLACEMENT</u>			
3.	a. Brush spring (5) and brush (6)	a. Raise spring	Use needle nose pliers.
		b. Insert brush into holder	Be sure pre-shaped brush is installed correctly for proper contact with commutator
		c. Release spring.	
	b. Brush lead (7) and screw (4)	Secure lead to motor	Use 3/16 in open end wrench
	c. Access cover (3) and screw (2)	Install and secure	Use cross tip screwdriver
<u>DISASSEMBLE - DRIVE COUPLING REPLACEMENT</u>			
1	Wiper motor (1)	a. 4 cap screws (8) and 4 lockwashers (9)	Unscrew and remove
		b. Bracket (10)	Remove

WINDSHIELD WIPER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	c. Retainer pin (12)	Punch out.	a. Use 1/8 in. punch and hammer. b If required extract with pliers.
	d Drive coupling (11)	Withdraw off shaft	Use pliers.
<u>ASSEMBLE - DRIVE COUPLING REPLACEMENT</u>			
2	a Drive coupling (11)	a Fit onto shaft b Aline retainer pin holes	
	b Retainer pin (12)	Insert	Use hammer
	c Bracket (10)	Fit in place	
	d 4 cap screws (8) and 4 lockwashers (9)	Install and secure bracket	



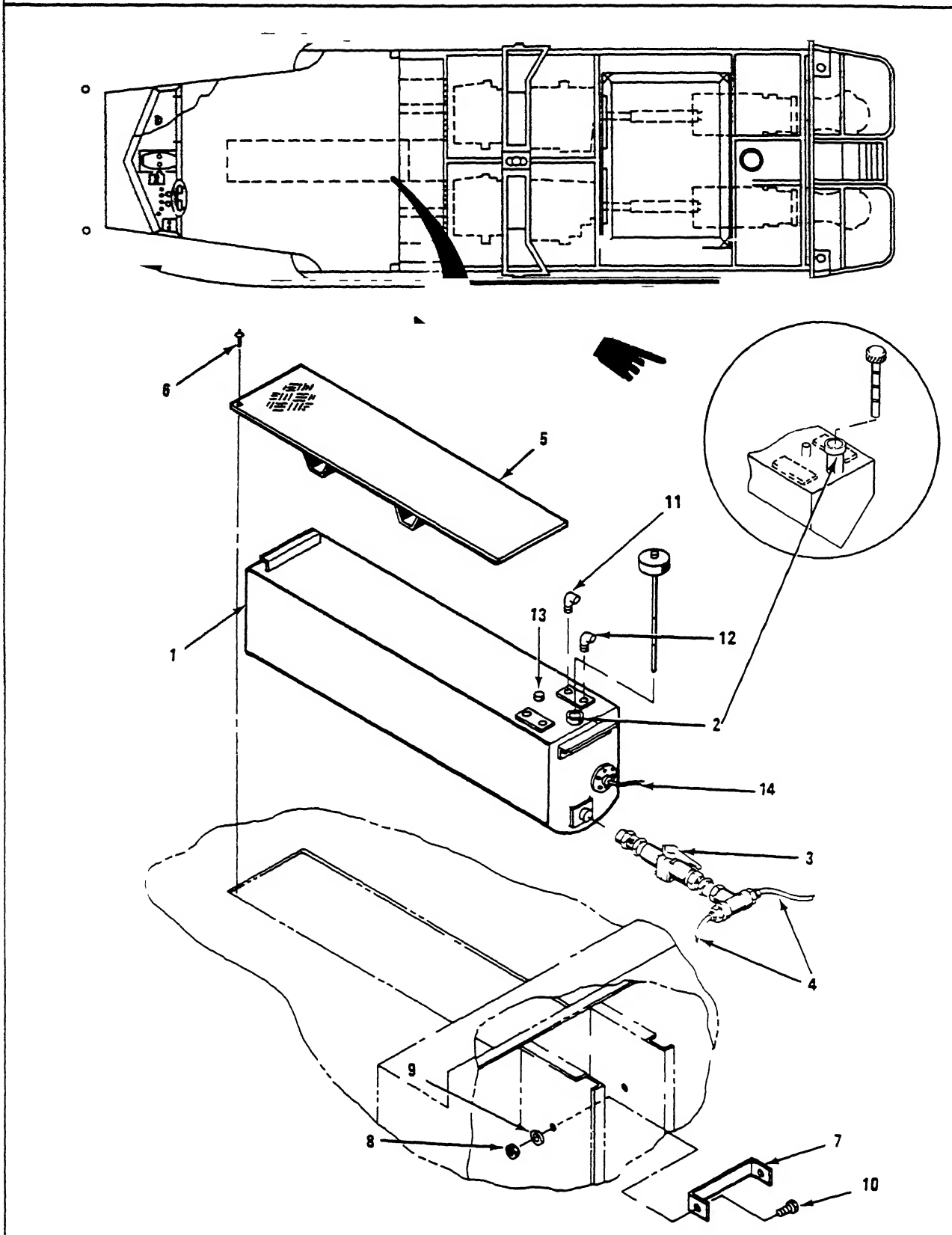
FUEL TANK REPLACEMENT INSTRUCTIONS**This task covers**

- | | |
|------------|--|
| a. Removal | c. Transfer of parts to replacement tank |
| b. Test | d. Installation |

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Dispensing pump, hand	TM 5-1940-277-20	Batteries disconnected.
3/8 in portable drill	TM 5-1940-277-20	Battery box lid removed.
1/4 in drill bit		
1/2 in open end wrench		
5/8 in open end box wrench		
Pipe wrench, 8 inch		
1/2 in box wrench		
Flat tip screwdriver, 6 inch		
Blind riveter, hand		
Air compressor		
Air control valve assembly		
1/4 in Punch		
Hammer		
Safety goggles		
Materials/Parts		
Pipe tape		
1 + 1/2 blind rivets		
Fuel tank		
Foam strips (packing)		
Personnel Required	Three	

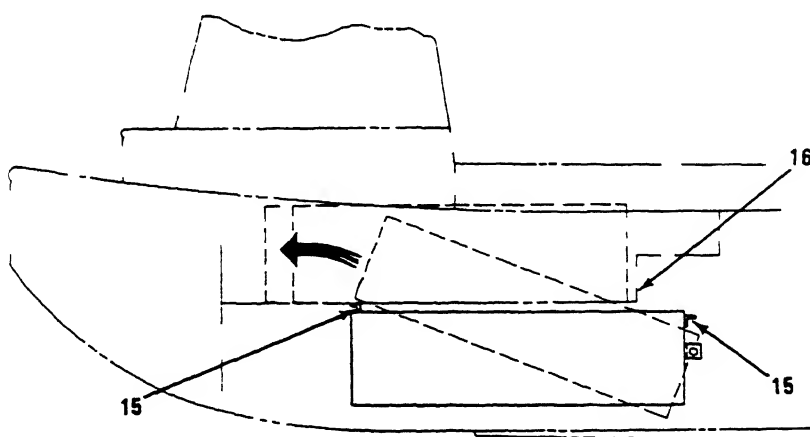
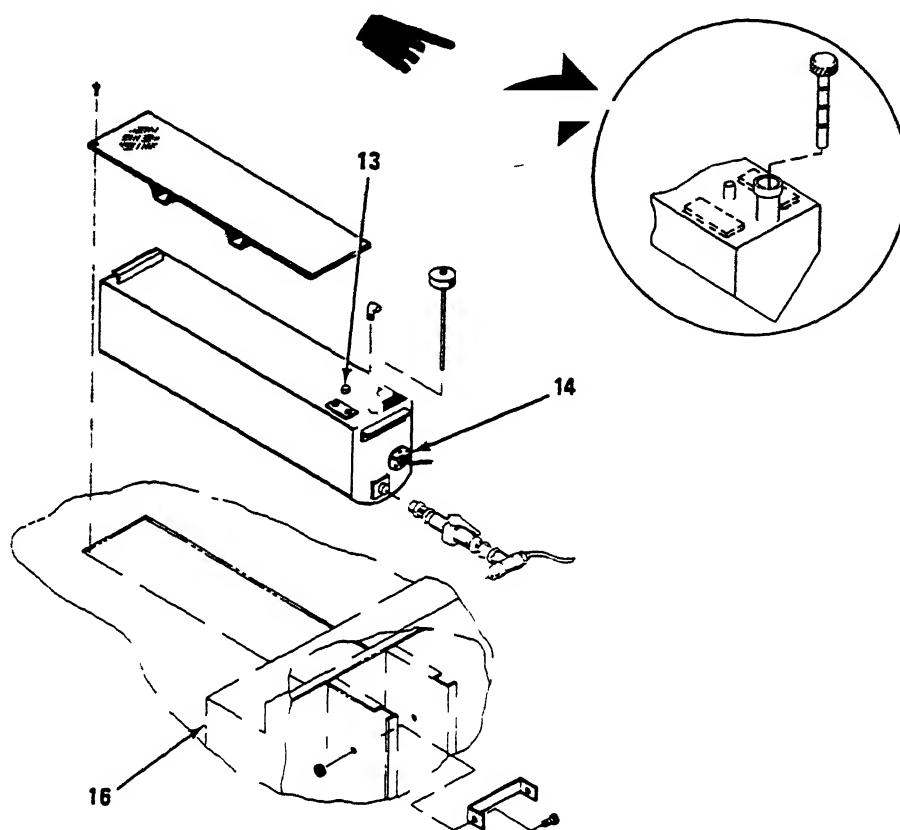
FUEL TANK REPLACEMENT INSTRUCTIONS
(Continued)



FUEL TANK REPLACEMENT INSTRUCTIONS
 (Continued)

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
1. Fuel tank (1)	Fuel tank (1)	Empty by a Pumping from filling pipe (2), or b. Isolate at main valve (3), disconnect fuel lines (4) downstream of valve, connect suction hose and pump	Use hand operated dispensing pump or suction pump
2 Forward cockpit	a Center line deck plate (5)	a Drill 44 ea rivets (6) until head pops off b Punch rivet through hole c Remove	Use 1/4 in drill bit and 3/8 in drill Use 1/4 in punch and hammer
	b Tie bar (7), 2 nuts (8), 2 washers (9), and 2 bolts (10)	Remove	Use 1 2 in box wrench and 1 2 in open end wrench
3 Fuel tank (1)	a 6 ea fuel lines at connections (11, 12)	Disconnect	Use 5/8 in open end box wrenches

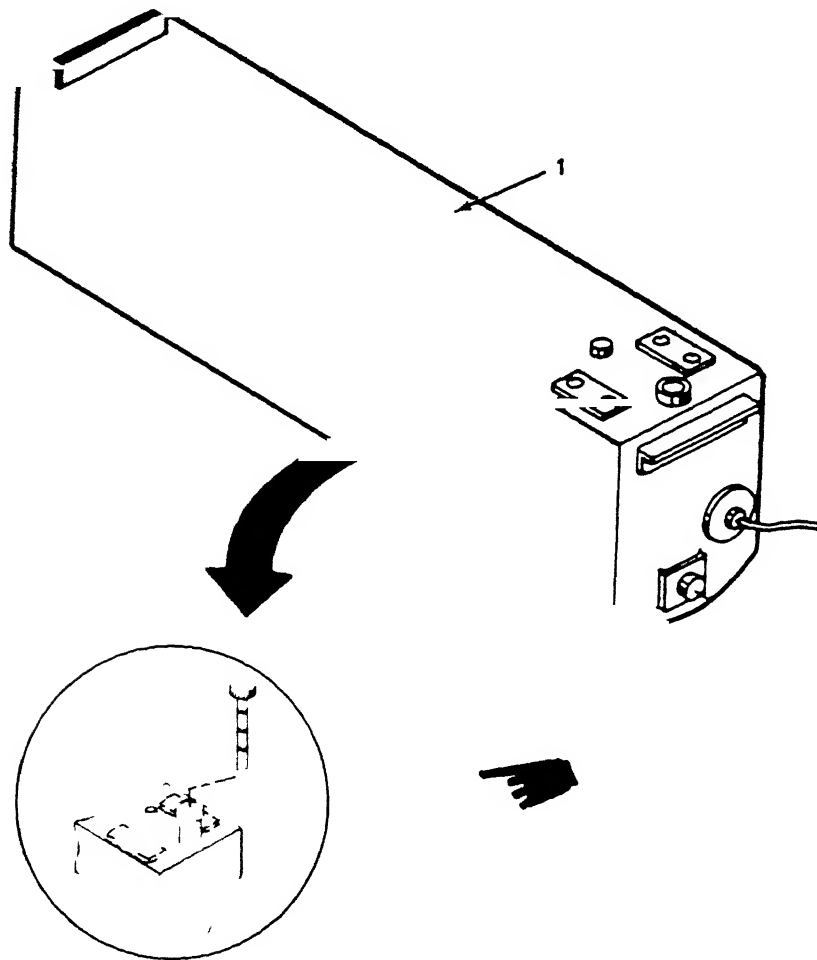
FUEL TANK REPLACEMENT INSTRUCTIONS
(Continued)



FUEL TANK REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>CAUTION</u>			
Minor fuel leakage will happen when disconnecting fuel lines Exercise care to prevent fuel from contaminating flotation blocks			
	b Vent hose at vent pipe (13)	Loosen clamp and remove	Use screwdriver
	c Fuel level sender lead (14)	Disconnect at first connection away from sender (unplug)	a Do not disconnect right at sender b If there is need to remove sender, see TM 5-1940-277-20 for instructions
<u>NOTE</u>			
Fuel tank is squeeze-fitted into its space using packing. Tank is not secured by any other means.			
	d Main fuel valve (3)	Remove valve and see fitting	See TM 5-1940-277-20
	e Fuel tank (1)	Lift tank out of its space by handles (1b)	Use at least three persons. Lift forward end and carefully pull tank under battery box (2) up into forward cockpit. Lift the rear end of fuel tank into cockpit as shown in figure.

FUEL TANK REPLACEMENT INSTRUCTIONS
(Continued)



FUEL TANK REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

TEST

WARNING

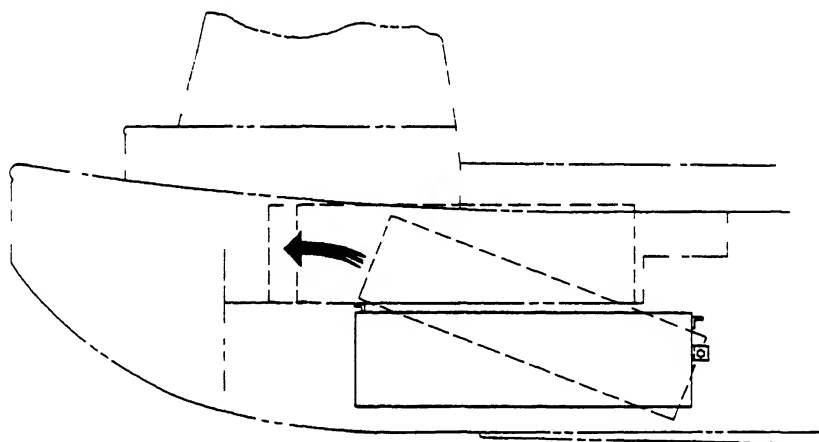
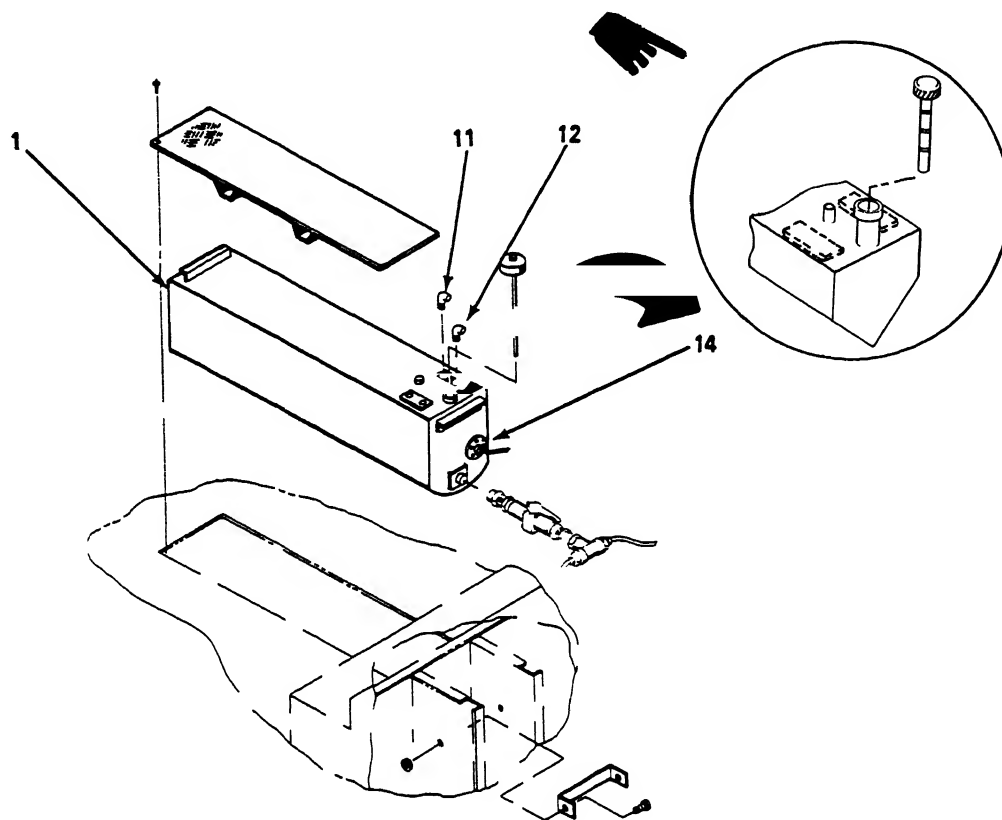
Do not weld used tank. Tank may explode. Severe burns can result.

WARNING

Always use safety goggles when using dry compressed air for cleaning. Do not use pressures greater than 30 psi. High air pressure can cause injury and cut the skin.

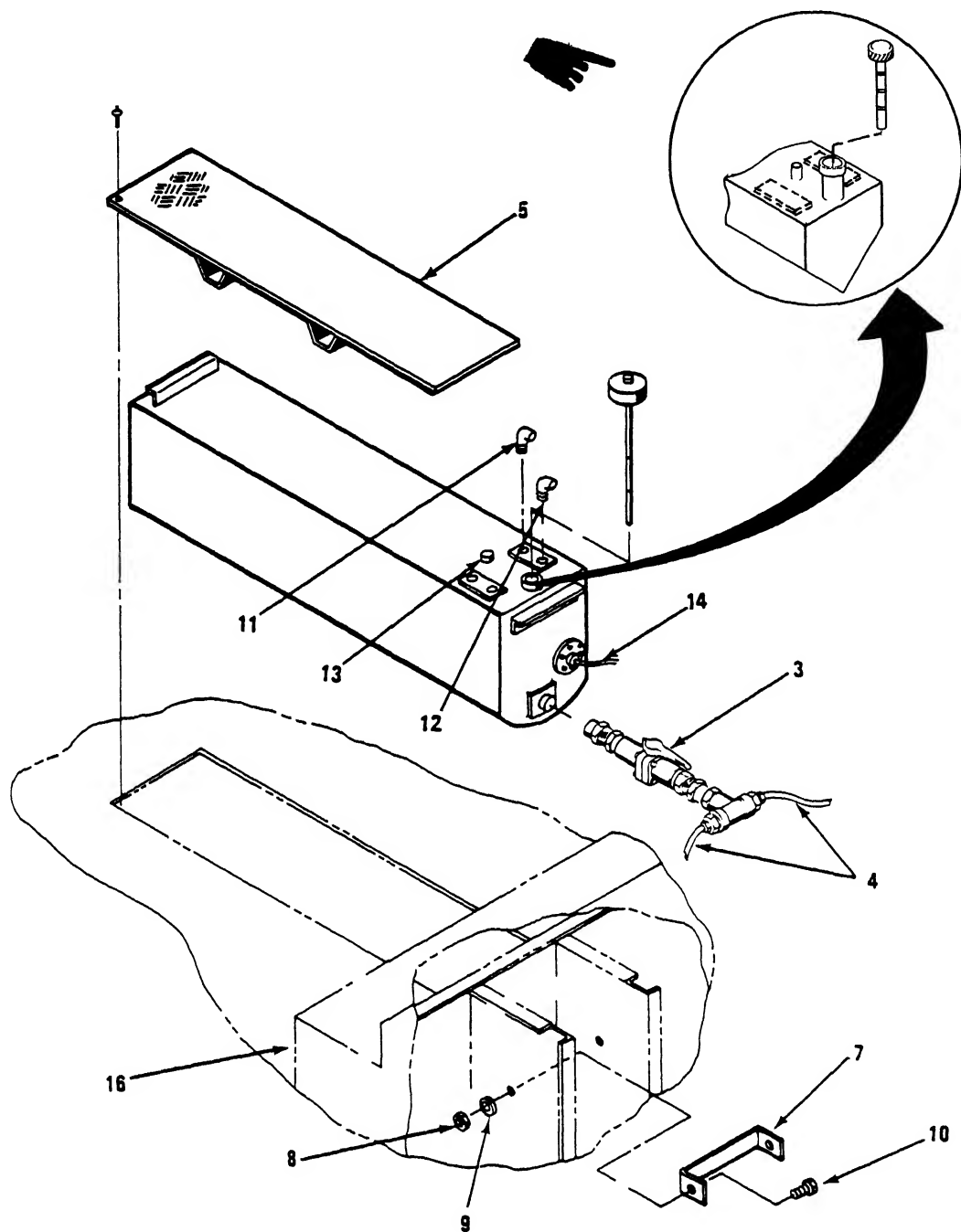
Fuel tank (1)	Fuel tank (1)	Test tank for leaks	Use air compressor and air control valve assembly.
		a. Close all openings.	
		b. Turn air line on.	
		Pressure will be 30 psi.	
		Test pressure at all joints.	
		When pressure has been released, remove pressure release plugs and air nozzle.	

FUEL TANK REPLACEMENT INSTRUCTIONS
(Continued)



FUEL TANK REPLACEMENT INSTRUCTIONS (Continued)			
LOCATION	ITEM	ACTION	REMARKS
<u>TRANSFER OF FITTINGS TO REPLACEMENT TANK</u>			
5. Fuel tank (1)	a 90° elbows (11, 12) for fuel return lines (4 each)	a. Unscrew b. Apply pipe tape	Use pipe wrench
	b Fuel level sender (14)	Transfer	See TM 5-1940-277-20
<u>INSTALLATION</u>			
6 Fuel tank (1)	a Fuel tank (1)	a Install new tank	
		b Check bulk- head cradle for foam strips	Make sure tank is completely seated in cradles and foam strips are preventing any metal-to-metal contact Foam strip on sides of tank should give tight fit, holding tank in place
		c Seat tank	
	b Fuel level sender lead (14)	Connect	

FUEL TANK REPLACEMENT INSTRUCTIONS
(Continued)



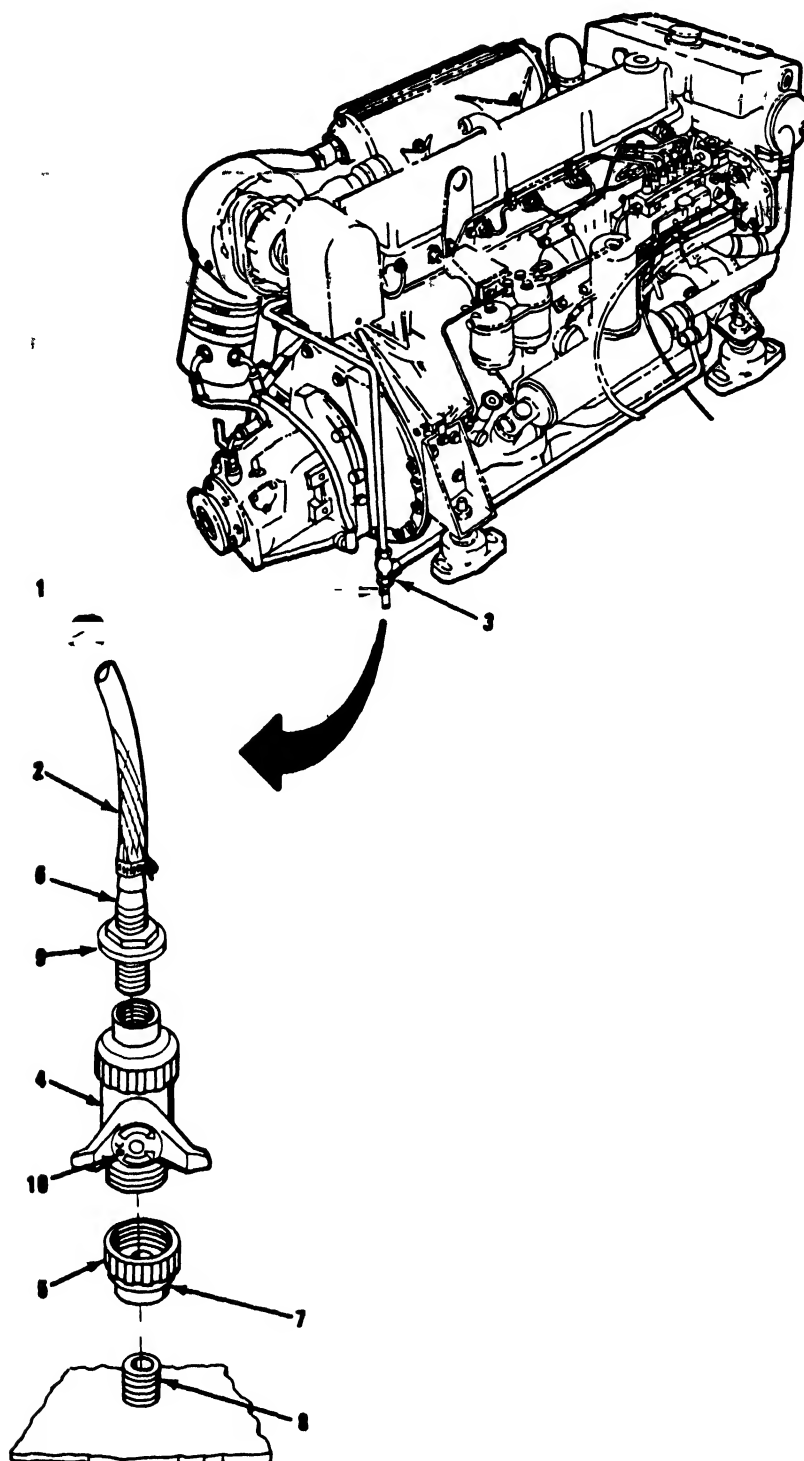
FUEL TANK REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	c Vent hose at vent pipe (13)	Connect, tighten hose clamp at vent pipe (13).	Use screwdriver
	d Main fuel valve (3)	a. Apply pipe tape b. Install	See TM 5-1940-277-20
	e 6 ea fuel lines at connections (11, 12, 4)	Connect	Use 5/8 in open end box wrench
7 Battery box (16)	a Tie bar (7), 2 nuts (8), 2 washers (9), and 2 bolts (10)	Install	Use 1/2 in box wrench and 1/2 in open end wrench
	b Center line deck plate (5)	a Position using markings b Rivet in place	Use 1/4 in aluminum blind rivets and blind riveter, hand

NOTE

Be careful to clean up clipped rivet pieces. It is possible that rivet cores are non-compatible metal which will cause corrosion spots if accidentally dropped in bilges.

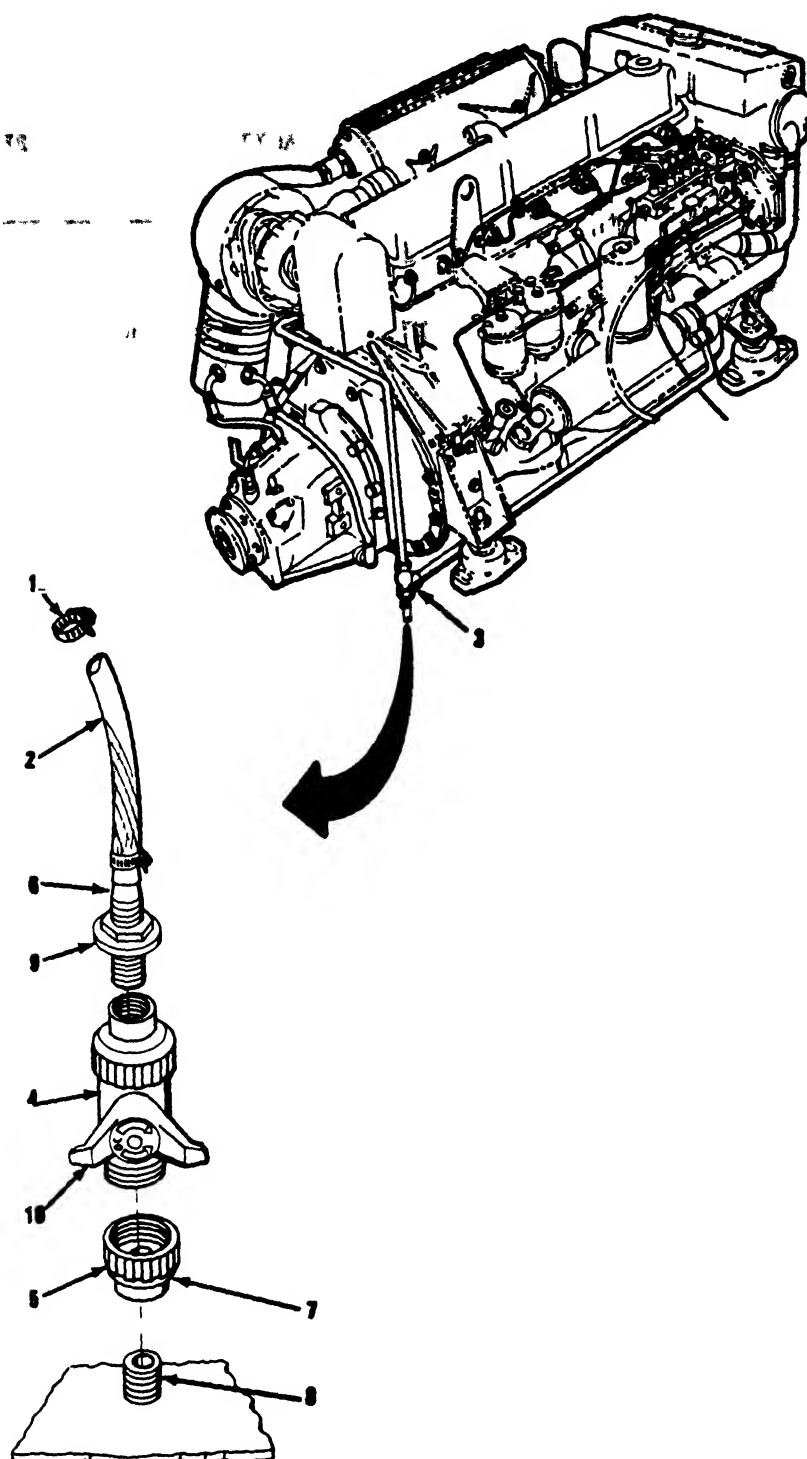
DRAIN DOWN VALVE REPLACEMENT INSTRUCTIONS (MK1)
(Continued)



DRAIN DOWN VALVE REPLACEMENT INSTRUCTIONS (MK1) (Continued)

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
1. Engine compartment	a. Hose (2)	a. Loosen hose clamp (1)	Use screwdriver
		b. Pull hose (2) off drain down pipe (3)	
	b Valve (4)	a Unscrew lower collar (5).	
		b Unscrew and remove plastic adapter (6)	a Use two pair of pliers
			b Retain adapter (6) with attached hose (2)
		c Unscrew lower fitting (7) with collar (5) from stub pipe (8)	Use pipe wrench

DRAIN DOWN VALVE REPLACEMENT INSTRUCTIONS (MK1) (Continued)



DRAIN DOWN VALVE REPLACEMENT INSTRUCTIONS (MK1)

(Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>INSTALLATION:</u>			
2. Engine compartment	a. Adapter (6) and stub pipe (8)	Coat threaded components lightly with pipe-compound.	Use pipe compound.
	b. New valve (4)	a. Screw lower fitting (7) with collar (5) onto stub pipe (8) until finger tight.	
		b. Screw plastic adapter (8) with attached hose (2) into valve (3) until finger tight.	
		c. Snug nut (9) down onto valve (4) finger tight	
		d. Assembly valve (3) to lower fitting (7) using collar (5) until finger tight.	Position valve handle (10) pointing to rear of boat for ease in reaching
	c. Hose (2)	Fit hose (2) onto drain down pipe (3) and secure using hose clamp (1).	Use screwdriver

24 122

2017

2017

2017

2017

2017

2017

2017

2017

2017

ALTERNATOR REPAIR INSTRUCTIONS

This task covers.

- | | | |
|----------------|-------------|------------------|
| a. Disassembly | d. Testing | g. Bench testing |
| b. Cleaning | e. Repair | |
| c. Inspection | f. Assembly | |

INITIAL SETUP

Tools	Equipment Condition	Condition Description
-------	---------------------	-----------------------

Vise	TM 5-1940-277-20	Alternator removed from engine.
------	------------------	---------------------------------

Vise jaw caps

Flat tip screwdriver, 6 in

Cross tip screwdriver, 6 in

Scribe

Non-metallic hammer

15/16 in box wrench

Soldering iron

Snap ring pliers

Air compressor

Air blow gun

Multimeter, TS-352B/U

Torque wrench (0 - 175 ft-lb)

15/16 in socket, 1/2 in drive

Generator and starter test stand

Cylinder support

Safety goggles

Press

Materials/Parts

Brush box gasket

O-ring, slip ring end shield

Solvent

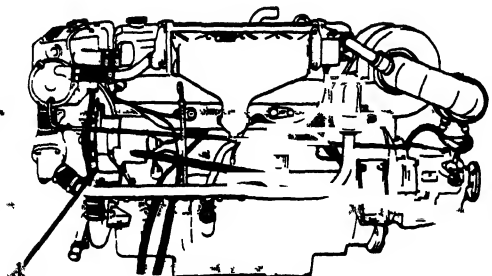
Brushes

Loctite

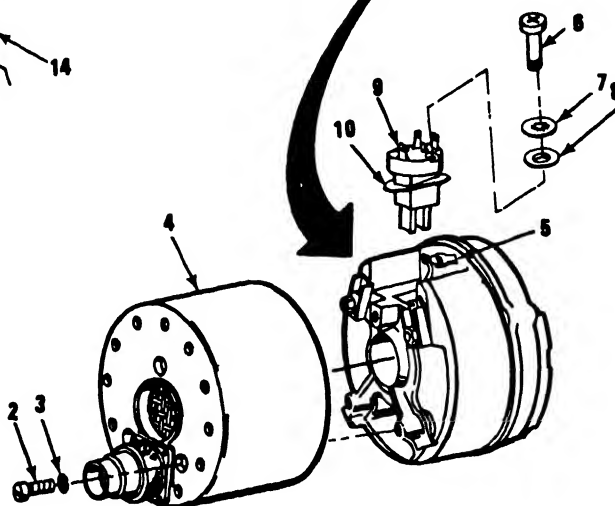
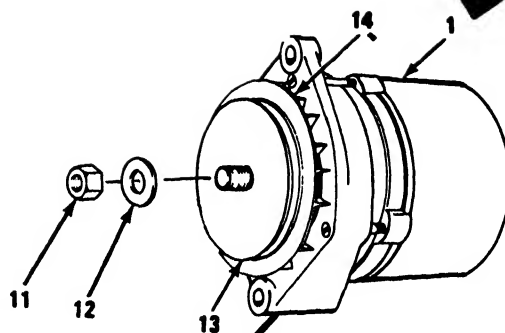
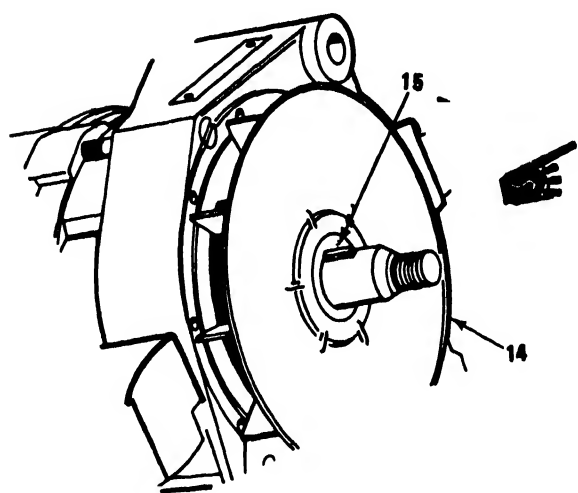
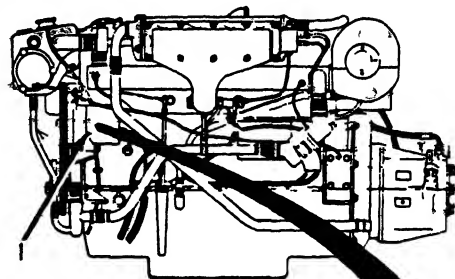
Lockwashers

ALTERNATOR REPAIR INSTRUCTIONS (Continued)

MK 1



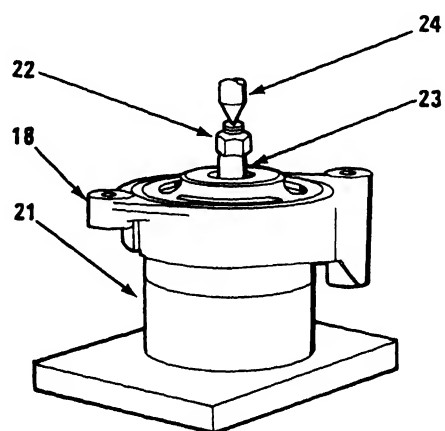
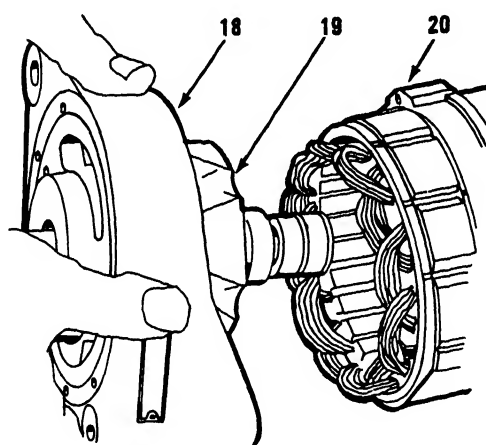
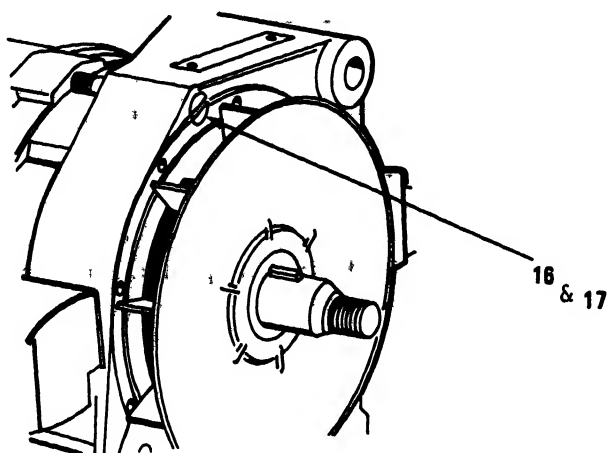
MK 2



ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>DISASSEMBLE</u>			
1	Alternator (1)	a. Remove all surface dirt and grease	Use solvent
		b. Lightly clamp in vise.	Use soft jawed vise.
	b 3 capscrews (2) and 3 lockwashers (3)	Unscrew and remove	Use flat tip screwdriver
	c Cowl (4)	Detach	
	d Tag (5)	Disconnect	
	e 2 capscrews (6), 2 washers (8) and 2 lockwashers (7)	Unscrew and remove	Use cross tip screwdriver
	f Brush box assembly (9) and gasket (10)	a Remove	
		b Discard gasket	
	g Pulley nut (11) and washer (12)	Remove	Use 15/16 in box wrench
	h Pulley (13), fan (14) and woodruff key (15)	Withdraw	

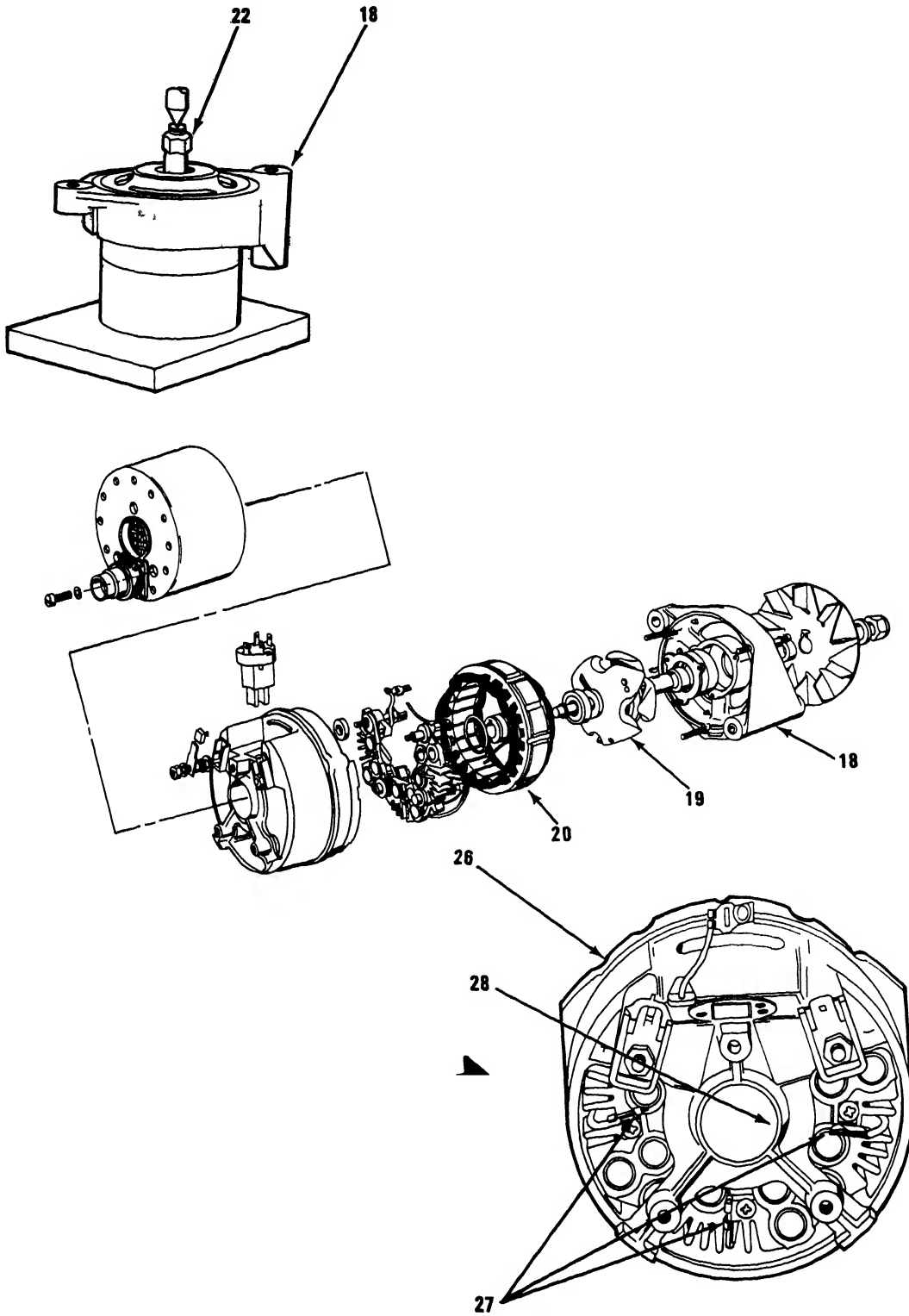
ALTERNATOR REPAIR INSTRUCTIONS (Continued)



ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	i. 3 through screws (16) and 3 lock-washers (17)	Unscrew and remove	Use flat tip screwdriver
	j Drive end shield (18) with rotor (19)	a Carefully withdraw from stator (20)	Tap lightly with hammer to separate
<p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">Do not damage slip rings when placing on table</p>			
		b Place over large diameter cylinder support (21)	Cylinder support must be large enough to encase rotor and small enough to slip inside drive end shield (18) and support assembly with three end shield webs seated squarely onto cylinder
		c Screw nut (22) onto shaft	This prevents rotor from dropping onto slip rings during disassembly
		d Press rotor shaft (23) from drive end shield (18)	Use press (24)
		e Remove from cylinder support	

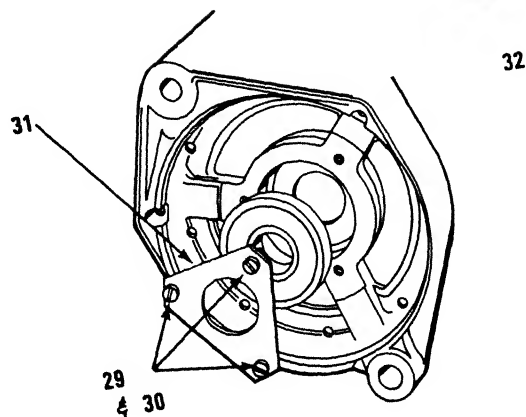
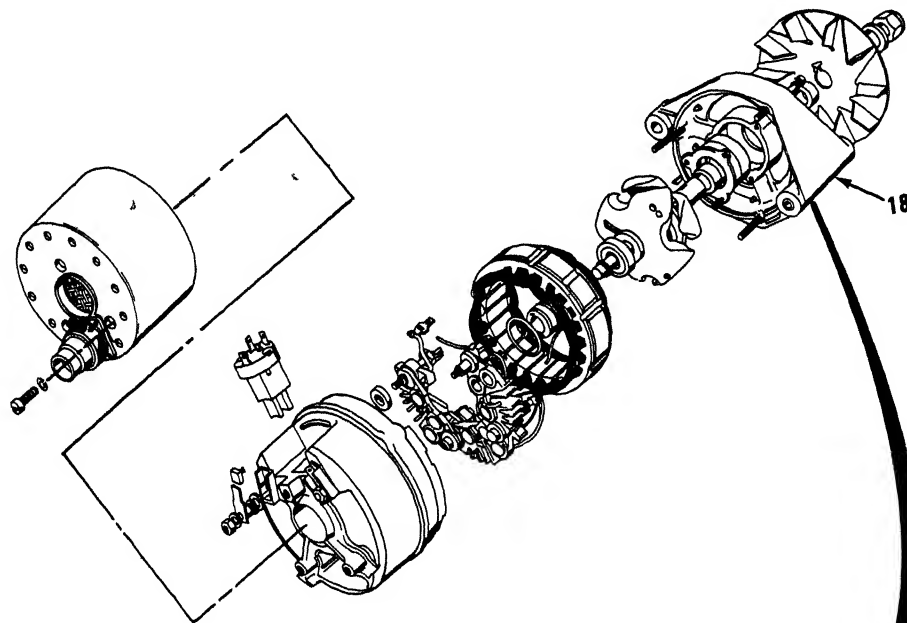
ALTERNATOR REPAIR INSTRUCTIONS
(Continued)



ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		f. Remove nut (22) from shaft.	
		g. Separate rotor (19) and end shield (18)	
2. Stator (20) and slip ring end shield (26)	Stator (20) and slip ring end shield (26)	a. Remove from vise.	
		b. Place on bench, end shield up	Take care when lifting that weight of stator is not taken by three stator leads.
		c. Unsolder 3 stator leads (27) from heat sink terminal tags	Use soldering iron
<p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">Do not remove tags from heat sinks</p>			
		d. Separate end shield (26) and stator (20)	
3 Slip ring end shield (26)	Bearing housing (28)	Remove and discard O-ring.	Take care not to damage O-ring groove.

ALTERNATOR REPAIR INSTRUCTIONS
(Continued)



ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
4. Drive end shield (18)	a. 3 screws (29), 3 washers (30) and clamping plate (31)	Remove.	Use flat tip screwdriver. Should screws be difficult to remove, heat end shield to 212° F
	b. Bearing (32)	Extract	Use suitable drift if required

CLEANING, INSPECTION, TEST, AND REPAIR

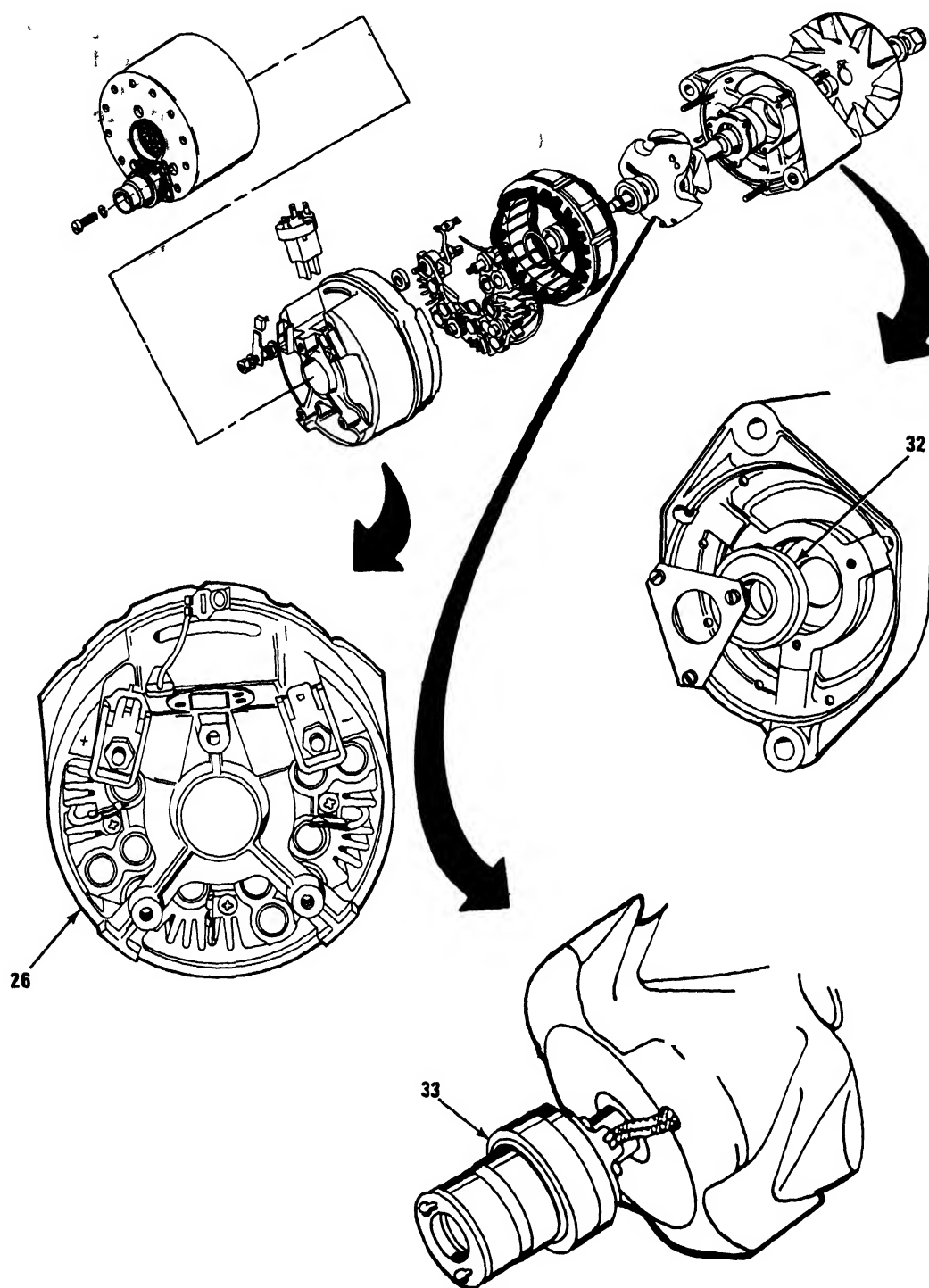
5	All components	a Clean thoroughly	Use dry cleaning solvent.
---	----------------	--------------------	---------------------------

WARNING

Always use safety goggles when using dry compressed air. Do not use pressures greater than 30 psi. High air pressure can cause injury and cut the skin.

- | | | |
|---|---|---|
| b | Remove all traces of carbon dust | Use low pressure compressed air. DO NOT spin bearings with compressed air |
| c | Inspect visually for Cracks, Corrosion, Local discoloration, and Wear | |

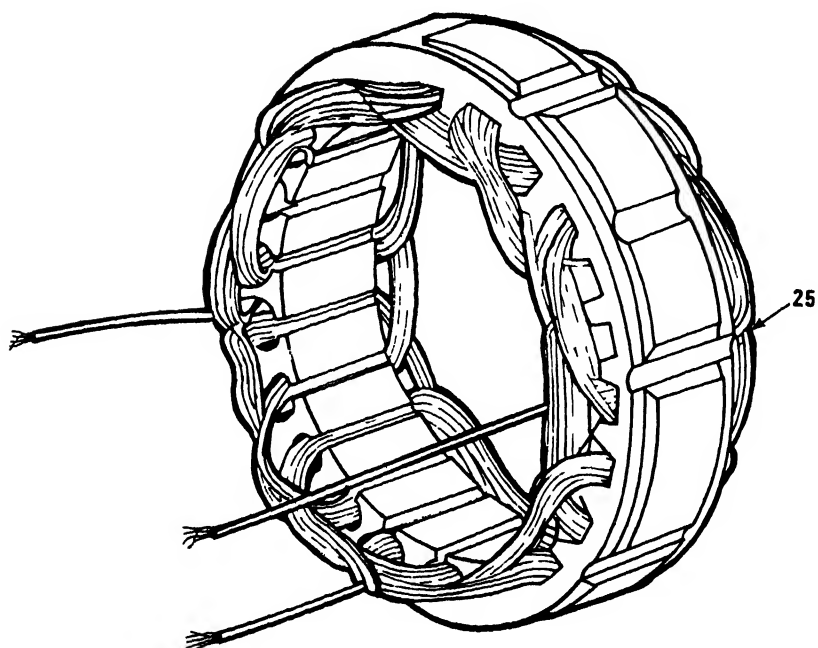
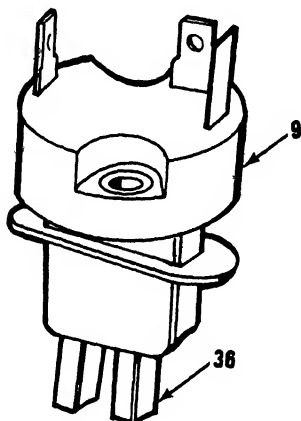
ALTERNATOR REPAIR INSTRUCTIONS
(Continued)



ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		d. Check all internal and external threads	
		e. Replace damaged or defective components	Note that self-locking pulley nut (11) can be reused provided nylon insert is in reasonable condition
6	Bearings (33 and 32)	a Examine for excessive play	
		b Spin by hand	
		c Replace bearing (32) if running dry or too much play	
		d If bearing (32) is defective replace rotor assembly	
7	Slip ring end shield (26)	a Examine internal bore of bearing housing	
		b Replace if signs of wear noted	Caused by outer race of bearing revolving

ALTERNATOR REPAIR INSTRUCTIONS
(COntinued)

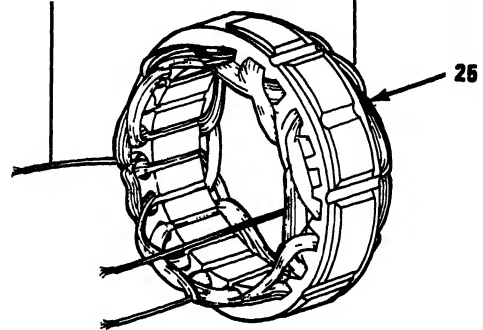
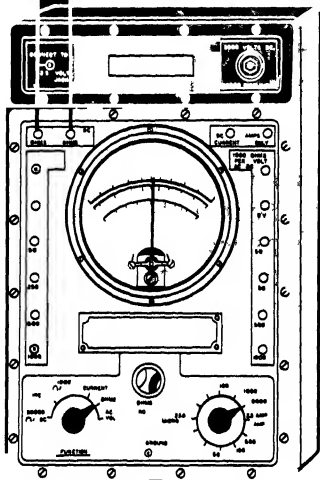


ALTERNATOR REPAIR INSTRUCTIONS (Continued)

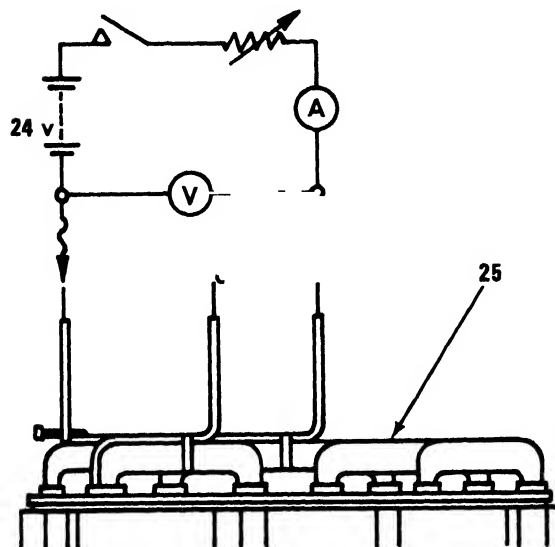
LOCATION	ITEM	ACTION	REMARKS
		c. Check fit of bearing (32) into housing.	
		d. If bearing is not tight fit when pressed-in replace end shield	
8	Brush box assembly (9)	a. Inspect for Cracks, Brushes (36) moving freely in slots, Brush (36) length, min 0 312 in (8 mm)	
		b. Replace if any defects noted	
9	Stator (25)	a. Examine windings visually to ensure they are properly secured and insulation is undamaged	
		b. Check leads for mechanical soundness and condition of insulation	

ALTERNATOR REPAIR INSTRUCTIONS (Continued)

(+) (-)



STATOR WINDING INSULATION TEST



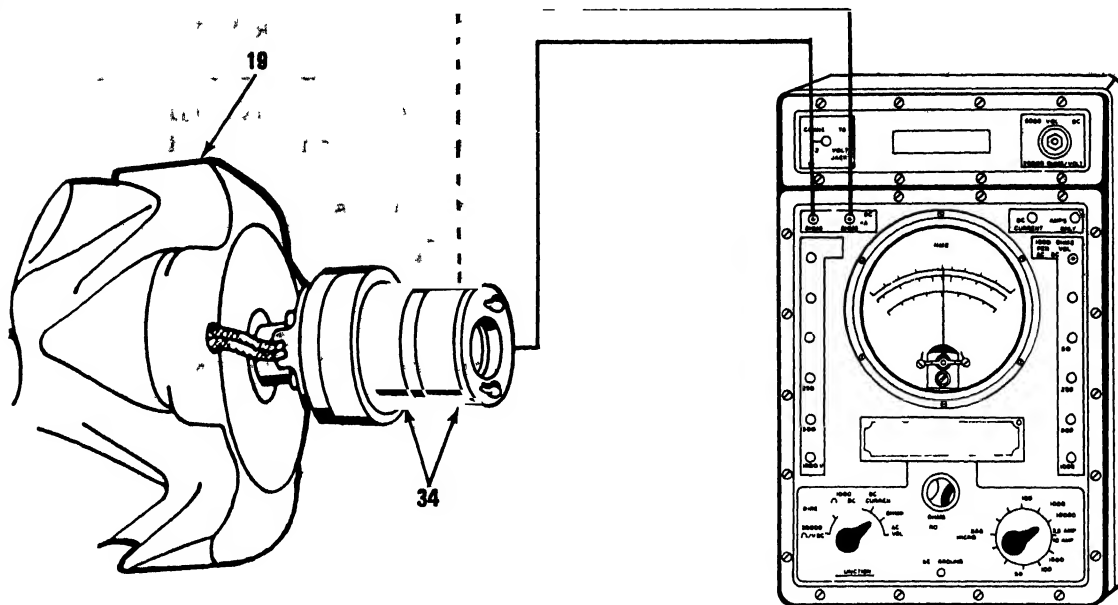
A - AMPMETER
V - VOLTMETER

STATOR COIL TEST CIRCUIT

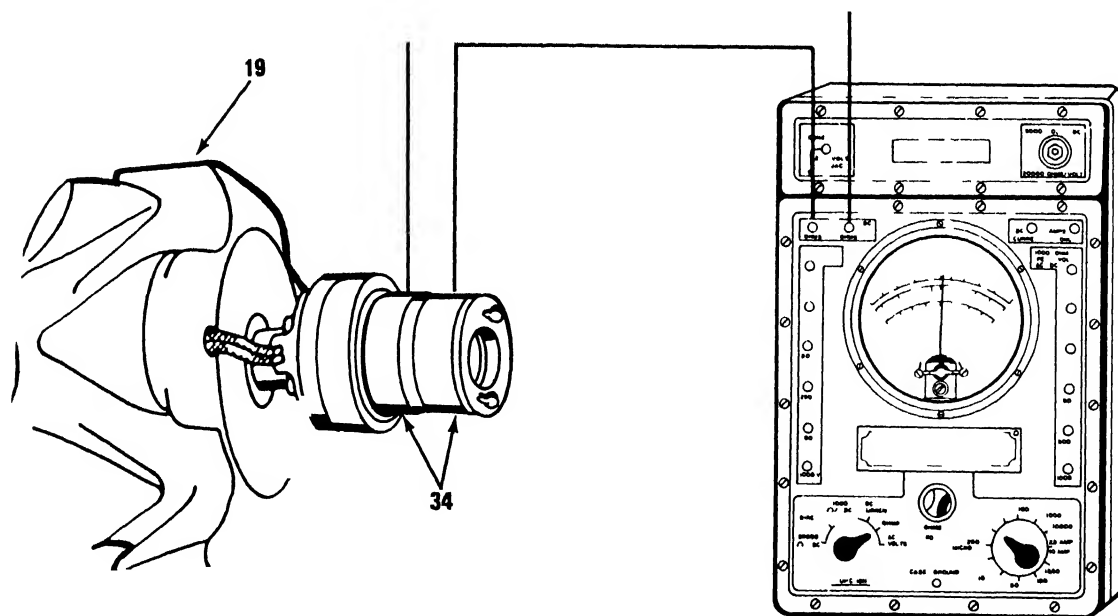
ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		c. Test resistance of each lead to frame. Minimum resistance of 10 Megohm.	Use multimeter (see figure).
		d. Test coils <ul style="list-style-type: none"> • Wire test circuit as shown in figure. • Close circuit and adjust variable resistor until current of 20 amperes is indicated • Note voltage • Repeat for each pair of leads • Each voltage reading should show 8 volt drop 	Use multimeter, ammeter, variable resistor, 24 V source and a switch or use automotive generator, alternator, and starter test stand, reference TM 9-4910-458-12.
		e. Replace stator if any defects noted.	

ALTERNATOR REPAIR INSTRUCTIONS
(Continued)



TEST INSULATION BETWEEN SLIP RINGS AND
ROTOR SHAFT

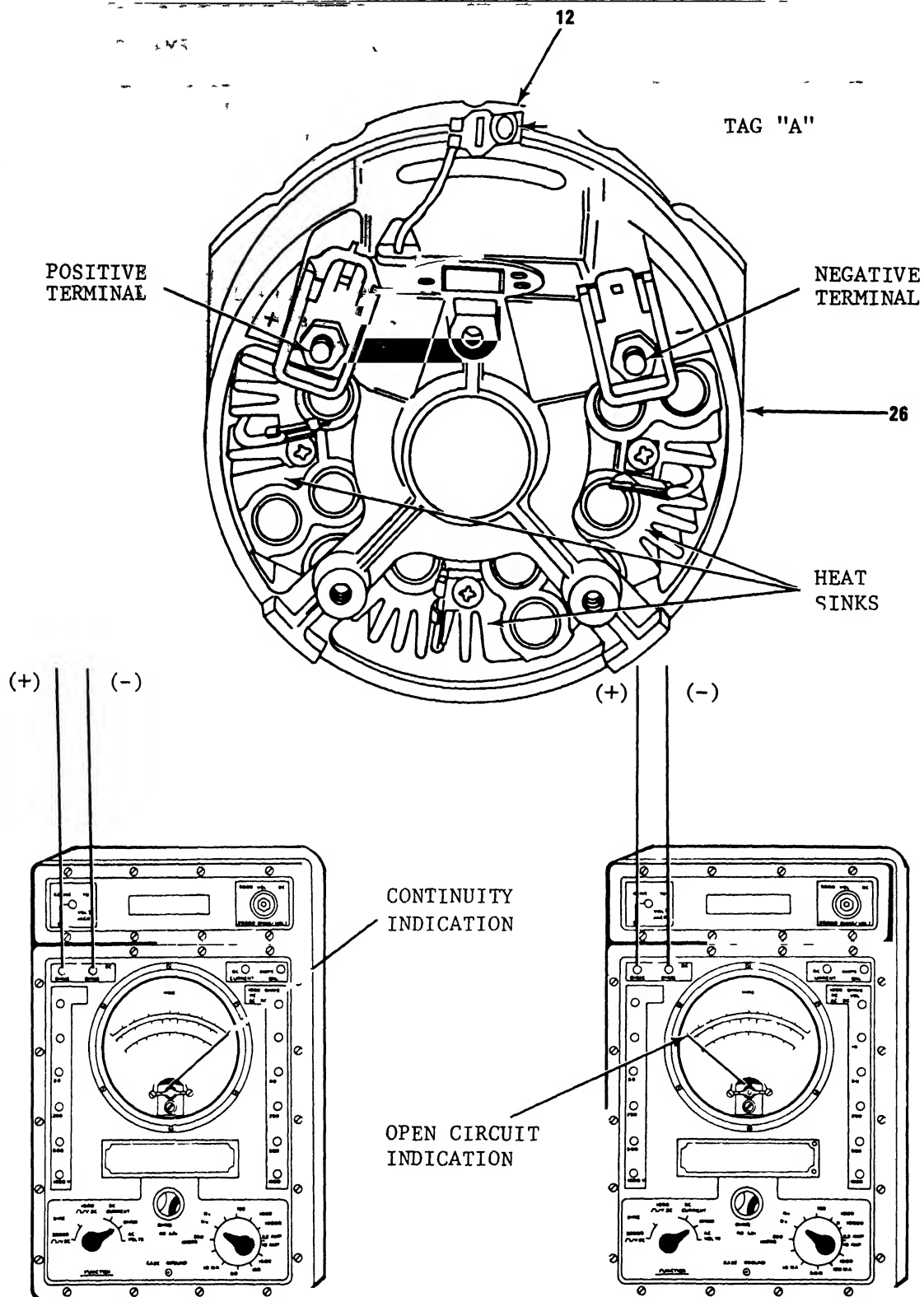


TEST RESISTANCE BETWEEN SLIP RINGS

ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
10.	Rotor (19)	<p>a. Examine visually for signs of cracking, denting, chipping or rubbing</p> <p>b. Examine field windings for deterioration of insulation and secured in place.</p> <p>c. Check insulation between each slip ring and rotor shaft Minimum 10 Megohm</p> <p>d. Test resistance between two slip rings (9 4 - 9 8 ohm acceptable)</p> <p>e. Replace rotor assembly if it fails to conform to a, b, c or d</p>	<p>Use multimeter (see figure)</p> <p>Use multimeter</p>
11	Slip ring (34)	<p>a. Examine for Pitting and Scoring</p> <p>b. Replace if defective.</p>	

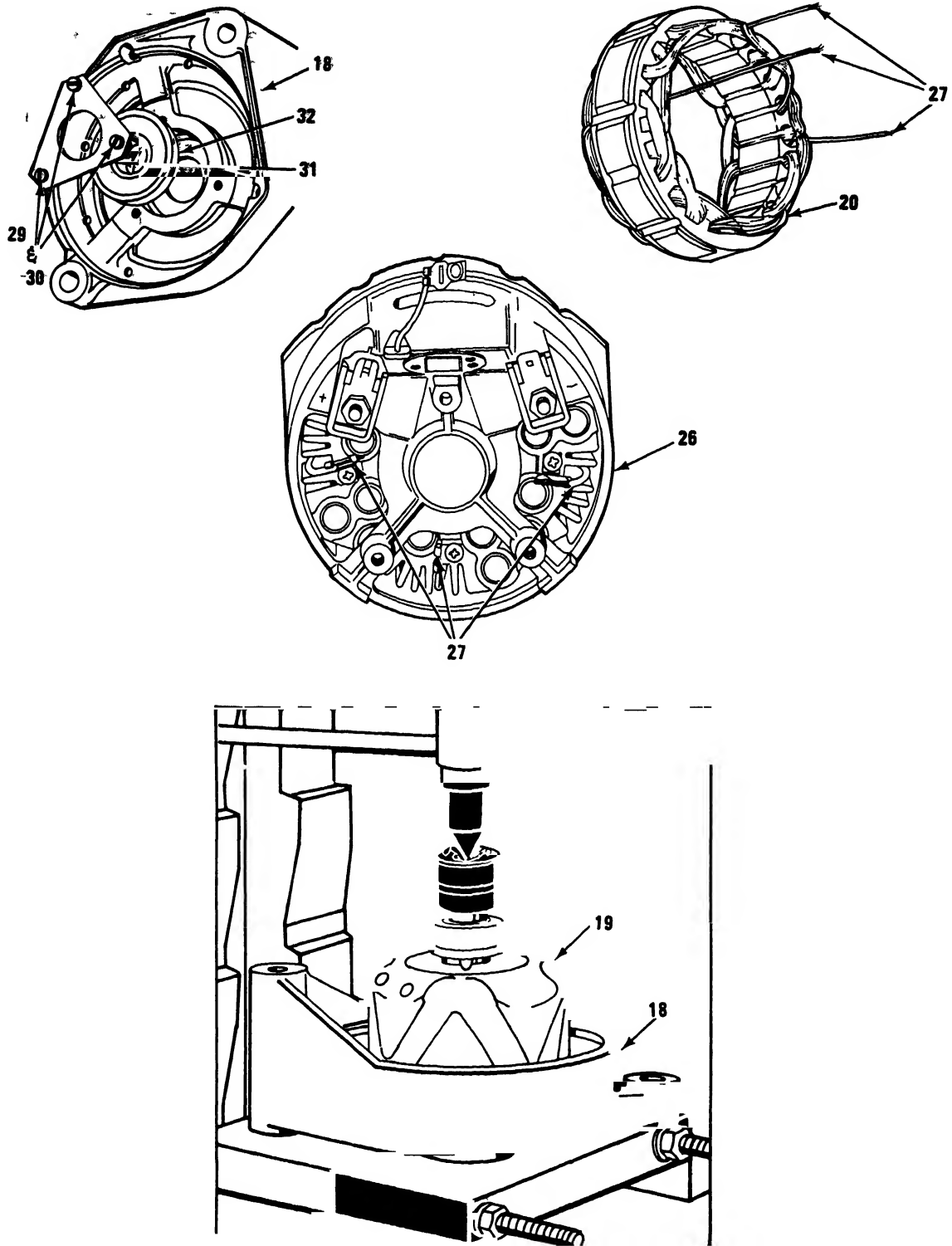
ALTERNATOR REPAIR INSTRUCTIONS (Continued)



ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
12. Slip ring end shield (26)	Diodes	a. Test diodes for serviceability using following table	Use multimeter MS-352B/U. Diodes can be tested while the three heat sinks are still assembled in the end shield.
Position of Test Probes			Needle Indication
Test	Positive Probe	Negative Probe	
1	Each heat sink in turn	Terminal +	To Full Right (Continuity)
2	Terminal +	Each heat sink in turn	No Movement (Open Circuit)
3	Terminal -	Each heat sink in turn	To Full Right (Continuity)
4	Each heat sink in turn	Terminal -	No Movement (Open Circuit)
5	Each heat sink in turn	'A' lead	To Full Right (Continuity)
6	'A' lead	Each heat sink in turn	No Movement (Open Circuit)
b. Replace heat sinks and end shields as a unit if any indication is incorrect			

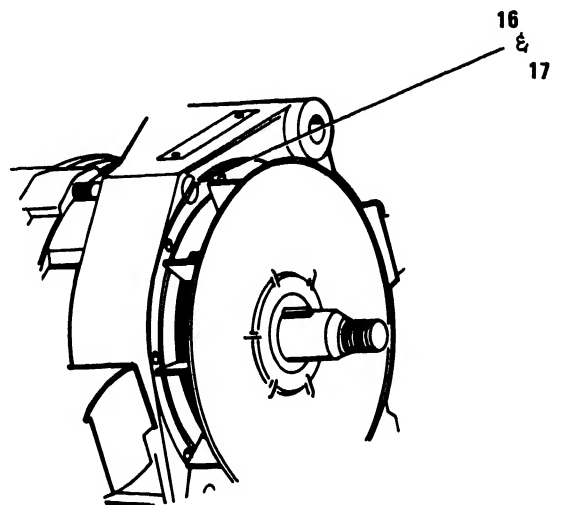
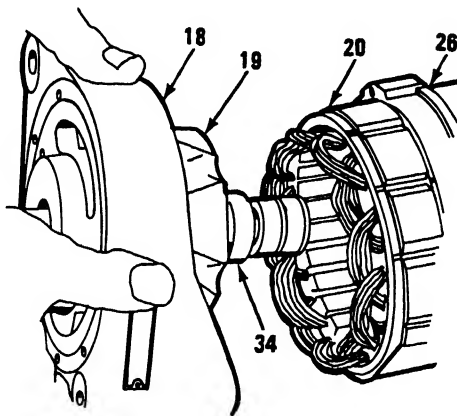
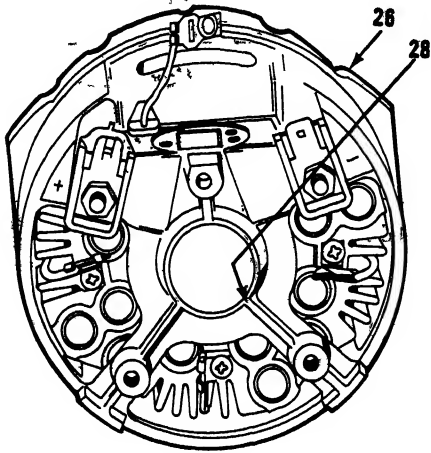
ALTERNATOR REPAIR INSTRUCTIONS
(Continued)



ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
13. Drive end shield (18)	a. Bearing (32)	Press into housing.	Make sure bearing is square to housing
	b. Clamping plate (31)	Position on end shield.	
	c. 3 screws (29) and 3 lock-washers (30)	Screw in and secure plate	Use flat tip screwdriver
14. Stator (20)	a. Stator (20)	Place on bench with 3 leads up	
	b. Slip ring end shield (26)	Lower end shield onto stator	Make sure three leads pass through three wide gaps in heat sink
	c. Stator leads (27)	a. Insert end in tag	
		b. Solder	Use soldering iron
15. Drive end shield (18)	a. Drive end shield (18)	Support on suitable surface	Surface should have hole to admit rotor shaft
	b. Rotor (19)	a. Fit bearing spacer	
		b. Press rotor shaft into bearing (32) in drive end shield (18)	Be careful not to damage slip ring, slip ring terminals or field coil leads

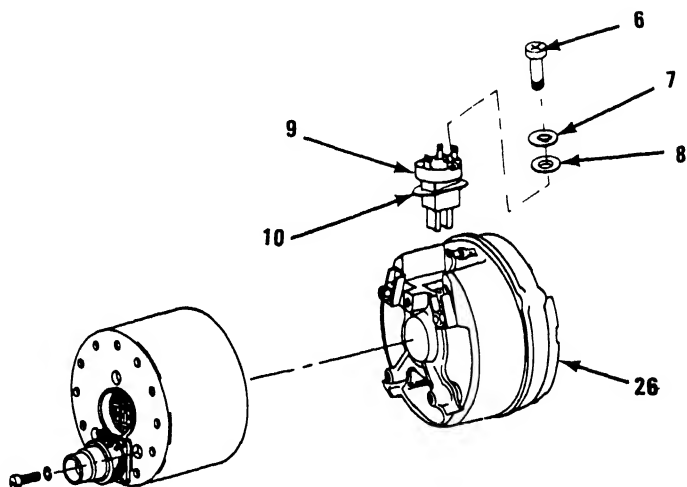
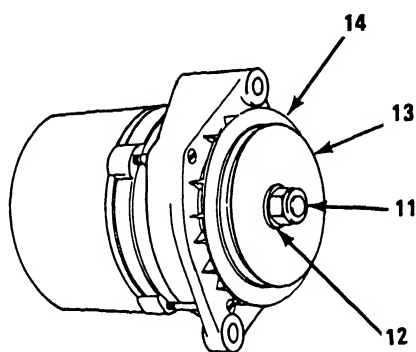
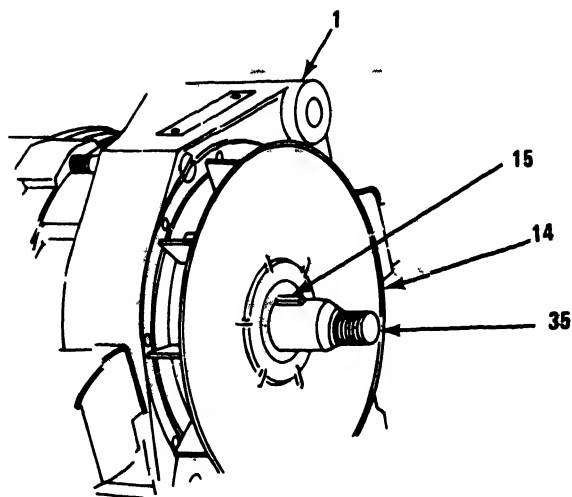
ALTERNATOR REPAIR INSTRUCTIONS (Continued)



ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
16. Slip ring end shield (26) and stator (20) assembly	a. O-ring	a. Fit into inside bearing housing (28).	
		b. Smear light coat of grease on inside of ring.	
	b. Rotor (19) and drive end shield assembly (18)	a. Support as shown on figure and insert rotor shaft through stator into bearing housing (28) so that slip ring bearing (33) enters bearing housing	Be very careful not to damage slip rings and windings.
		b. Press end shield up to stator as far as possible by hand	
	c. 3 through-screws (16) and 3 lock-washers (17)	a. Fit lockwashers to each screw	
		b. Coat screw threads with loctite	
		c. Insert screws through end shield	

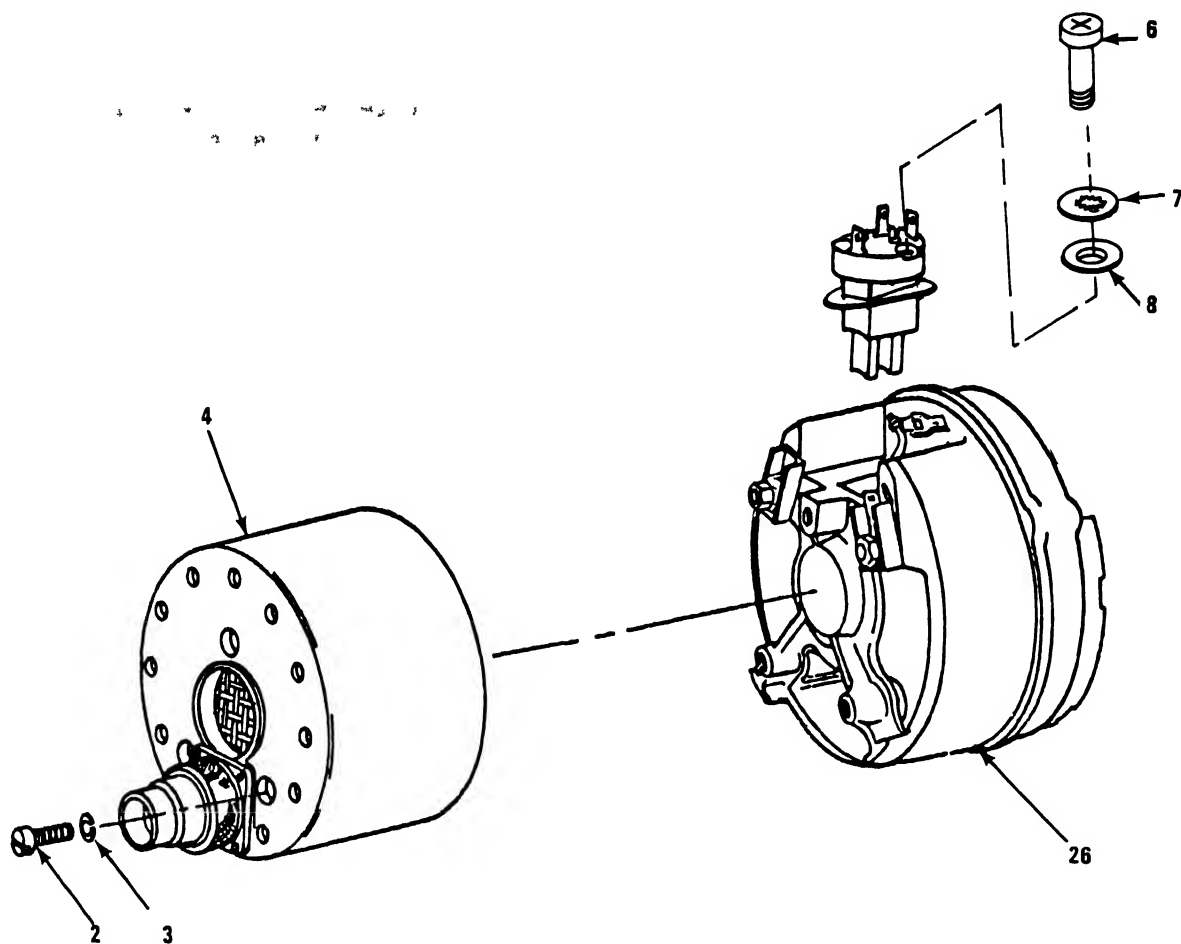
ALTERNATOR REPAIR INSTRUCTIONS
(Continued)



ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		d. Clamp entire assembly lightly in soft jawed vise.	
		e. Tighten each screw progressively in turn while lightly tapping end shield with hammer.	Use flat tip screwdriver and hammer.
17. Alternator (1)	a. Woodruff key (15)	Fit into position	
	b. Fan (14)	Slide onto shaft	
	c. Pulley (13)	Slide onto shaft	
	d. Washer (12)	Slide onto shaft	
	e. Nut (11)	Screw on, torque to 40 ft-lb (5 3 kg/m)	Use torque wrench, 15/16 in socket
	f. Shaft (35)	Tap with non-metallic hammer then spin rotor to check for free rotation	
	g. Brush box assembly (9) and gasket (10)	Assemble to slip ring end shield (26).	

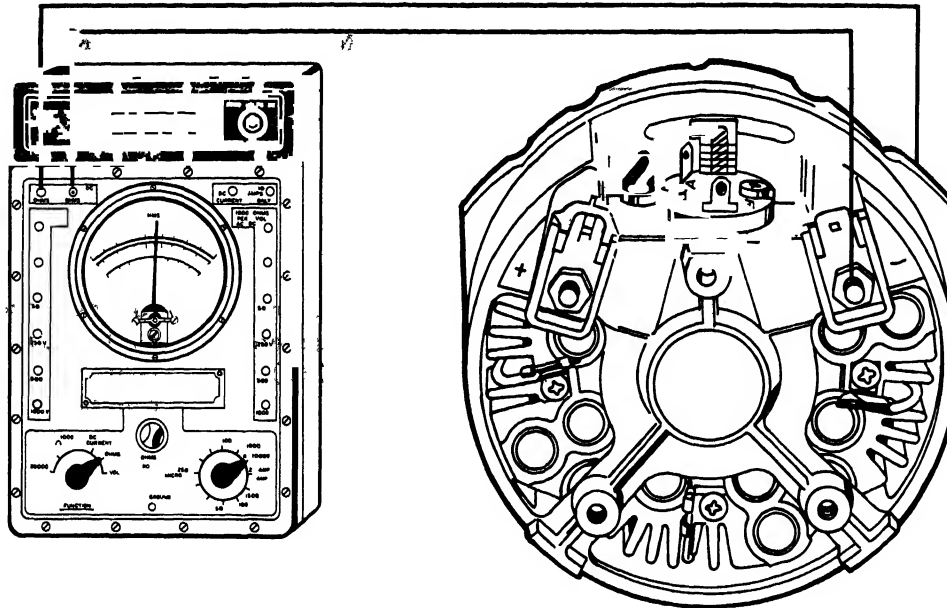
ALTERNATOR REPAIR INSTRUCTIONS (Continued)



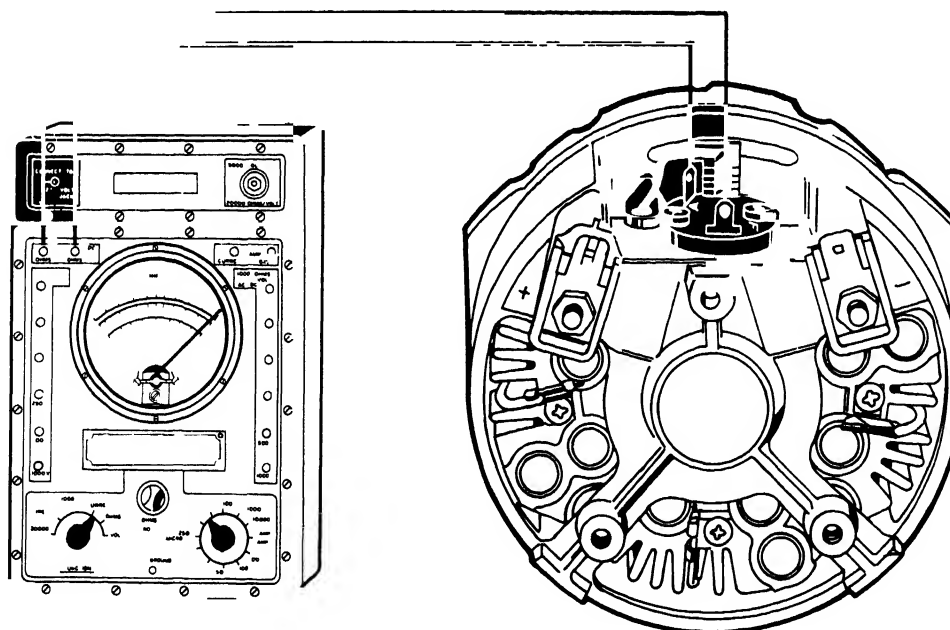
ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	h. 2 screws (6), 2 washers (8) and 2 lock- washers (7)	Screw in to secure brush box.	Use cross tip screwdriver
	i. Cowl (4)	Position on slip ring end shield (26)	Do not assemble cowl until bench tests are com- pleted.
	j. 3 capscrews (2) and 3 lockwashers (3)	Screw in to secure cowl.	Use flat tip screwdriver.

ALTERNATOR REPAIR INSTRUCTIONS
(Continued)



ALTERNATOR INSULATION TEST



FIELD COIL CIRCUIT CONTINUITY CHECK

ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>BENCH TEST</u>			
18. Alternator	a. Insulation (faults)	a Secure one test lead to housing.	
<p style="text-align: center;"><u>CAUTION</u></p> <p>Do not apply this test between any two terminals. Serious damage will be caused to the diodes.</p>			
		b Connect other lead to each terminal in turn Minimum resistance 10 Megohms	
	b Field coil circuit (continuity)	a Select lowest resistance range on multimeter	Use multimeter
		b Attach probes to terminals A and F	A low resistance should be indicated
		c Rotate rotor slowly by hand	a Low resistance indication should vary slightly
			b Large variation usually indicates sticking brushes or dirty slip ring
		d Correct any faults noted	

ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		i. Turn field current rheostat slightly clockwise to maintain 28V on DC voltmeter	
		j If load ammeter does not read 25 5A turn variable load rheostat until rated current output is obtained	
		k Check the DC field ammeter Should read 20A	
NOTE			
Record all meter readings			
		l Turn field current rheostat fully counterclockwise	
		m Turn master load switch OFF	
		n. Turn battery switch OFF	
		o. Reduce variable drive speed to 1000 RPM	

ALTERNATOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		p. Press STOP button	
		q. Turn main power OFF	
		r Return all switches and controls to base setting	
		s Disconnect all cables from alternator and test stand	
	f Test results	Evaluate If alternator output was 24V on DC voltmeter, 23 0 - 25 5 amps on load ammeter and 18 - 20 on field ammeter the alternator is serviceable If field ammeter reading is low check for open circuits or high resistance in field circuit If field ammeter reading is high check for grounds or short circuits in field circuit If voltage output all right but load ammeter reading low check stator windings and rectifier	



1

2

3

4



ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS**This task covers**

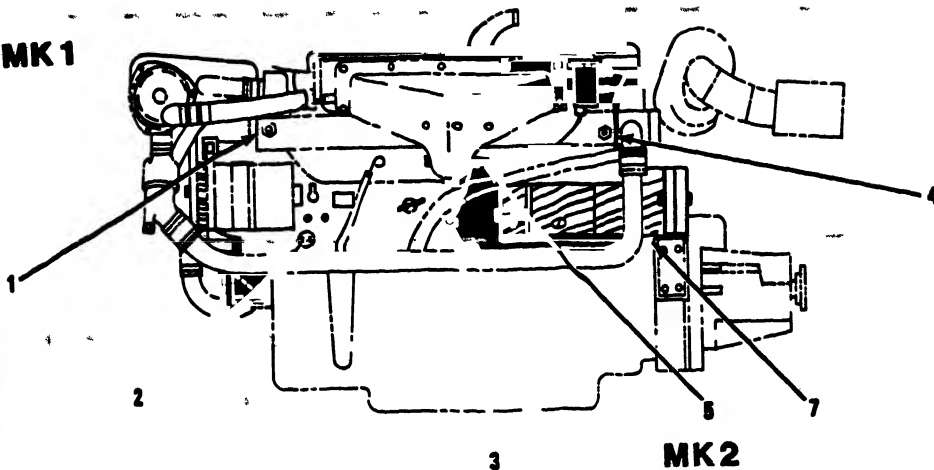
- a. Removal
- b. Installation

INITIAL SETUP

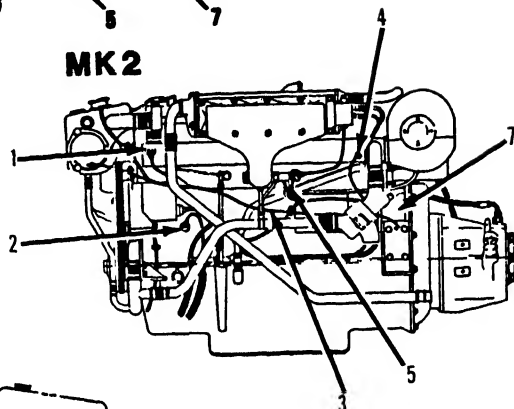
Tools	Equipment Condition	Condition Description
Flat tip screwdriver (stubby)	TM 5-1940-277-20	Battery hatch open.
Diagonal cutting pliers	TM 5-1940-277-20	Batteries disconnected.
7/16 in open end wrench	TM 5-1940-277-20	Engine hatches open.
7/32 in socket, 1/4 in drive	TM 5-1940-277-20	Control box cover removed.
1/2 in socket, 3/8 in drive		
11 mm socket, 1/4 in drive		
8 mm socket, 1/4 in drive		
7 mm socket, 1/4 in drive		
1/4 in drive ratchet		
3/8 in drive ratchet		
1-5/8 in open end wrench		
Materials/Parts		
Engine wiring harness		
Tape, electrical, plastic		
Ties, cable, nylon		

ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS (Continued)

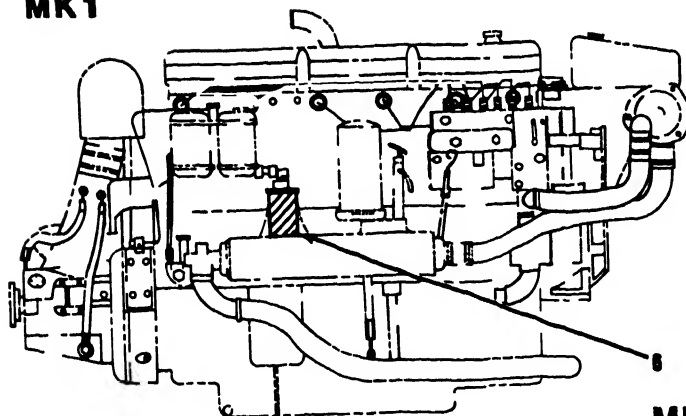
MK 1



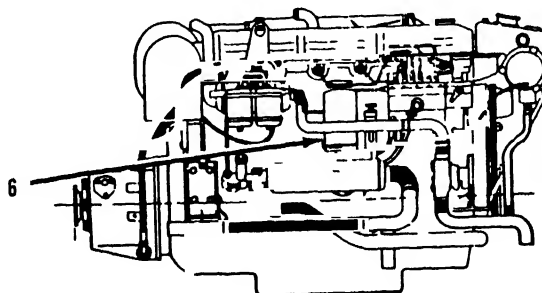
MK 2



MK 1



MK 2

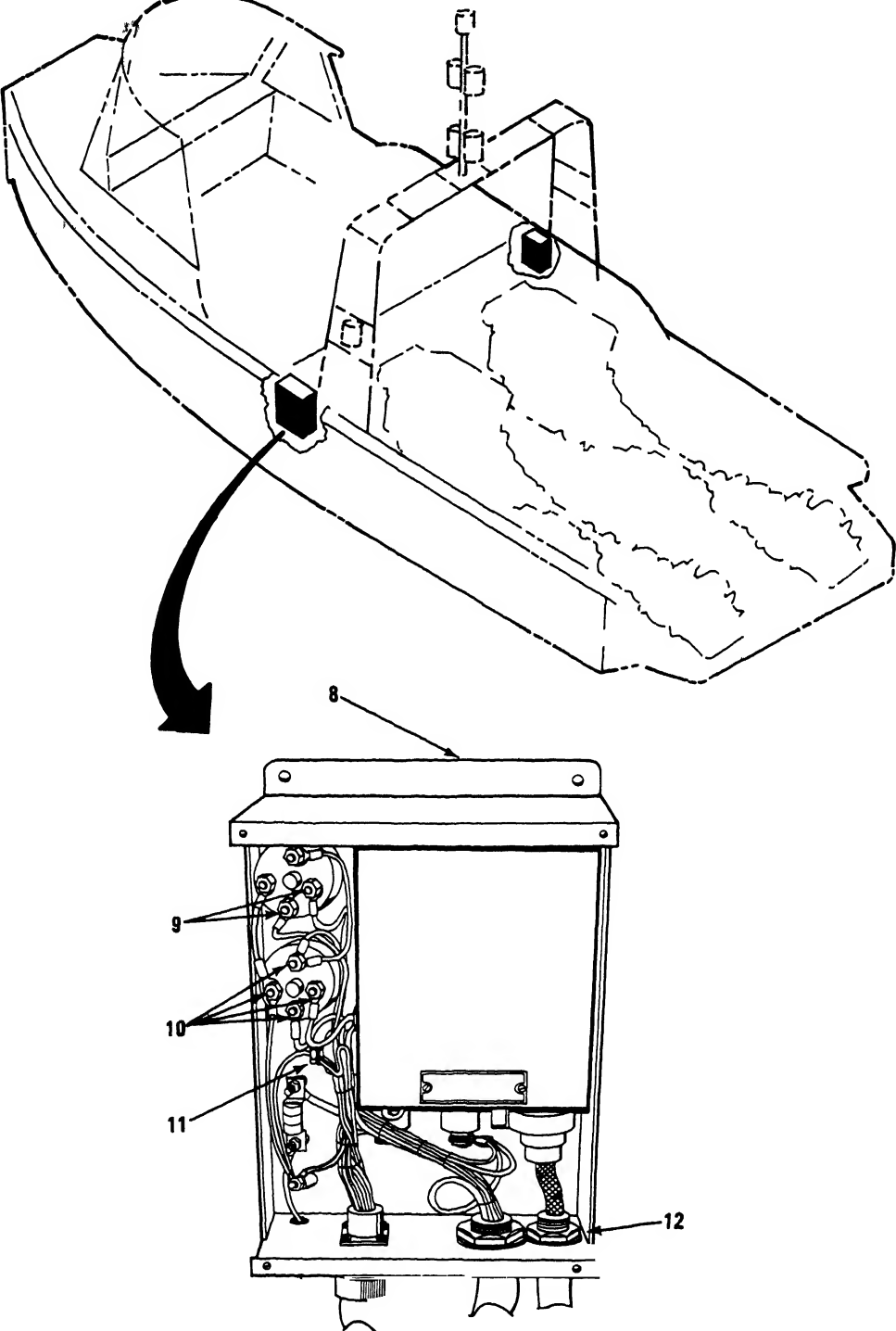


ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
NOTE			
Before starting any disconnecting, draw a sketch of wire hookup recording position and color of wire			
<u>REMOVAL</u>			
1. Engine	a. Water temperature sending leads (1)	Disconnect	Unplug
	b. Oil pressure sending leads (2)	Disconnect.	Use 7 mm socket.
	c. Low oil pressure sending leads (3)	Disconnect	Unplug
	d. High temperature sending leads (4)	Disconnect	Unplug
	e. Thermostart leads (5)	Disconnect	Unplug
	f. Tachometer leads (6) (behind fuel filters)	Disconnect	Use 7 mm socket
2 Starter (7)	a. Lead to small S terminal	Disconnect	Use 8 mm socket
	b. Two small leads to small R terminal	Disconnect	Use 8 mm socket

ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS
(Continued)

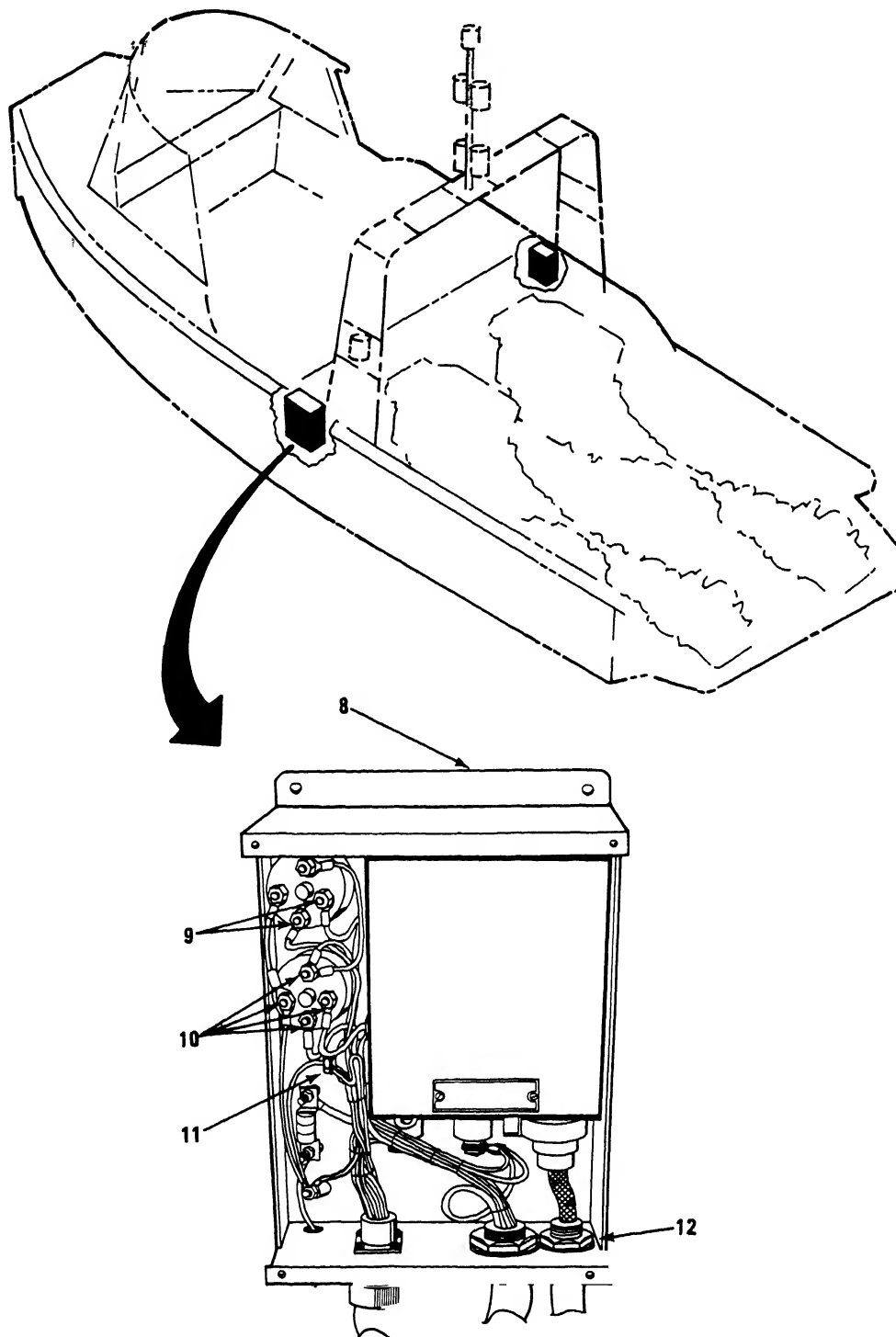


ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
	c. Three small leads to R- (negative) terminal	Disconnect.	Use 1/2 in socket. Leave heavy inter-engine battery and battery cables connected
	d. Two small leads to B+ (positive) terminal	Disconnect.	Use 1/2 in socket. Leave heavy battery cable connected
3. Control box (8)	a. Starter solenoid leads (9)	Disconnect two leads by removing two nuts and washers.	Use 11 mm socket on one large nut Use 8 mm socket on smaller nut
	b. Thermostart solenoid leads (10)	Disconnect leads by removing four nuts and washers	Use 11 mm socket on two larger nuts Use 8 mm socket on smaller nuts
	c. Capacitor leads (11)	Disconnect two places by removing one nut and washer each location	Use 7/16 in open end wrench One connection on bottom of regulator box, one on side
	d. Nut (12)	Unscrew and leave loose on cable	Use 1-5/8 in wrench.

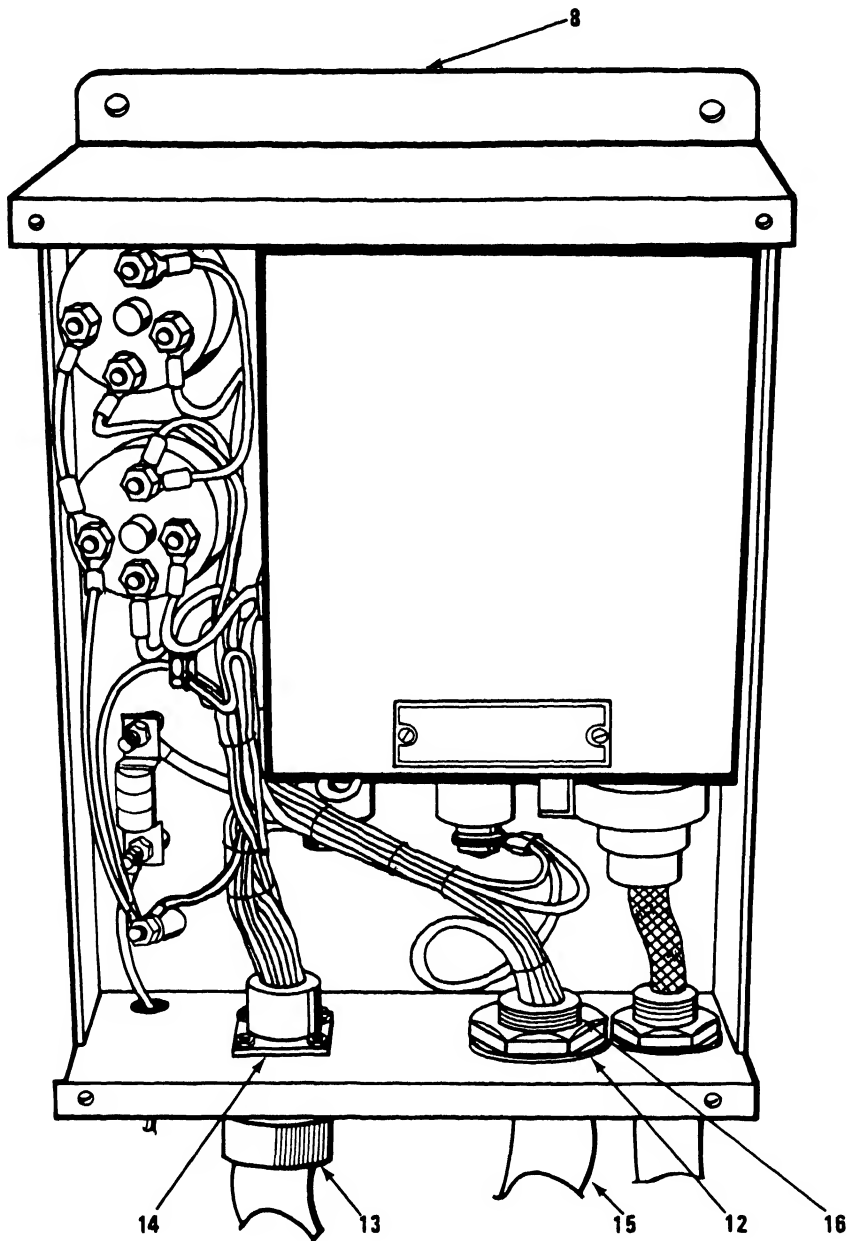
ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	c. Three small leads to R- (negative) terminal	Disconnect.	Use 1/2 in socket. Leave heavy inter-engine battery and battery cables connected
	d. Two small leads to B+ (positive) terminal	Disconnect.	Use 1/2 in socket. Leave heavy battery cable connected
3 Control box (8)	a Starter solenoid leads (9)	Disconnect two leads by removing two nuts and washers	Use 11 mm socket on one large nut. Use 8 mm socket on smaller nut
	b Thermostart solenoid leads (10)	Disconnect leads by removing four nuts and washers	Use 11 mm socket on two larger nuts Use 8 mm socket on smaller nuts
	c Capacitor leads (11)	Disconnect two places by removing one nut and washer each location	Use 7/16 in open end wrench One connection on bottom of regulator box, one on side
	d Nut (12)	Unscrew and leave loose on cable	Use 1-5/8 in wrench

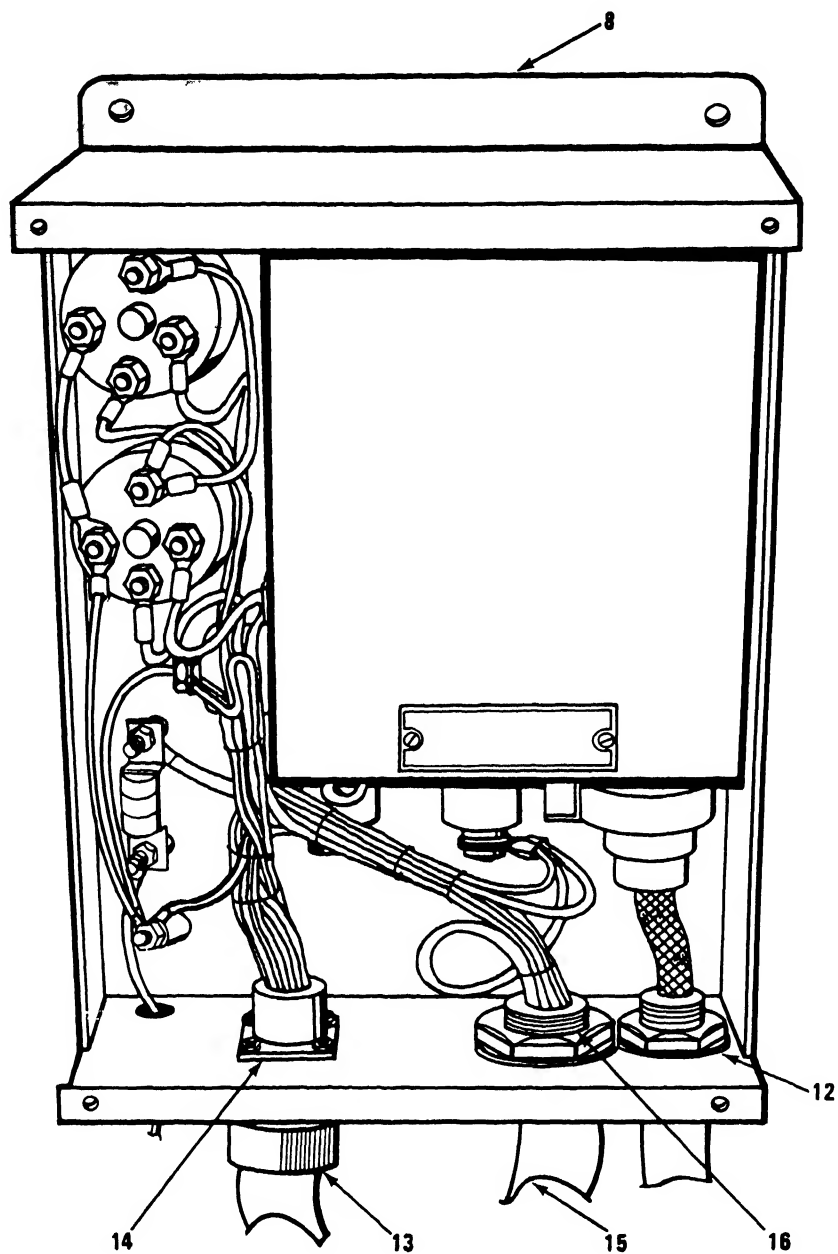
ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	e Connecting cable (13), control box to console	Disconnect by unscrewing retaining ring on socket and pulling socket away from control box	Use hands
	f Receptacle securing screw (14)	Remove four nuts and screws	Use 7/32 in socket and screwdriver This frees receptacle
NOTE			
Observe cable routing and make notes for use during installation of new cable.			
	g Wire ties holding wiring harness cable to other cables	Locate and cut with diagonal cutters	
	h Wiring harness cable (15)	Pull down until fitting (16) that nut (12) was attached to is clear of box Slide fitting off cable toward engine	Retain fitting for installation to new cable
	i Wiring harness cable (15)	Slide back through hole in control box until cable is removed	Use both hands Work cable out in short moves

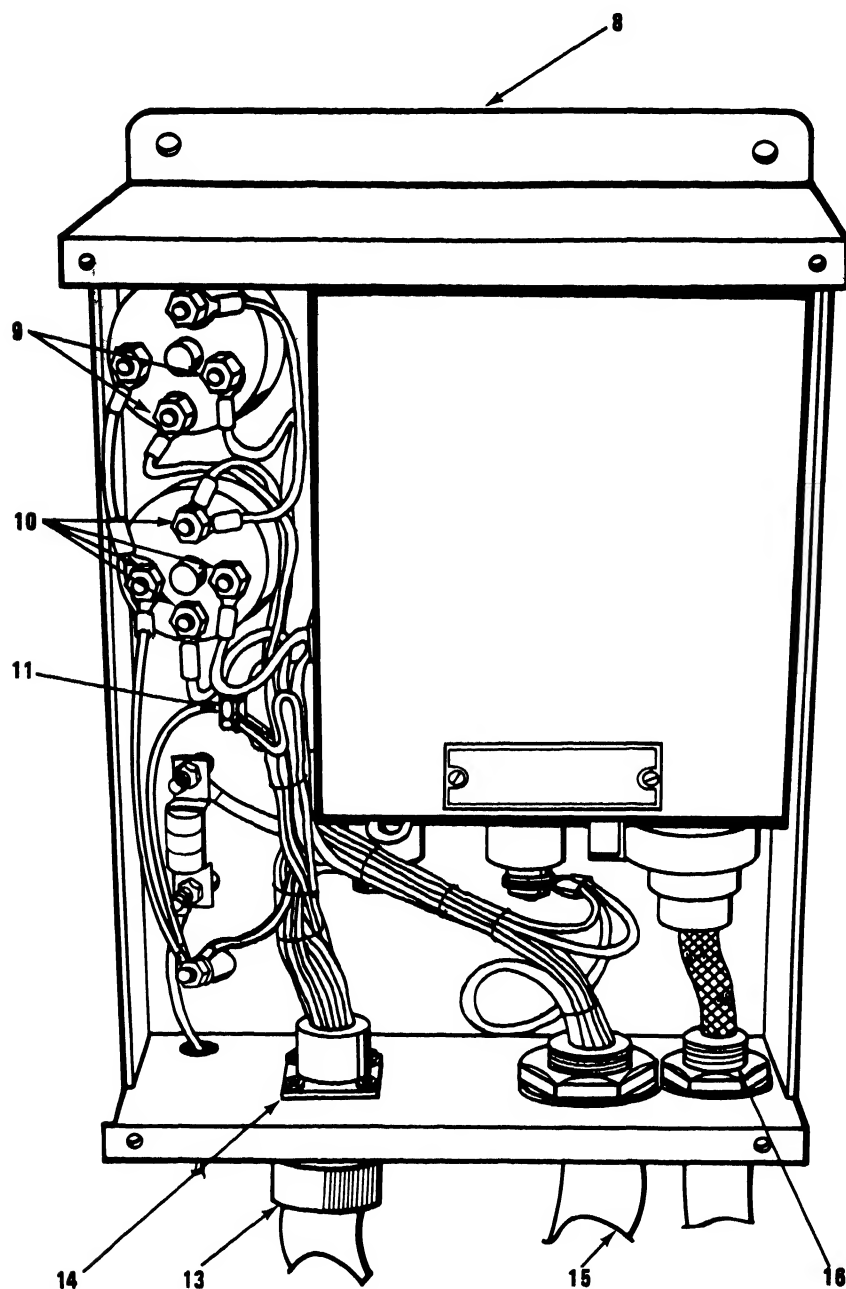
ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
4. Wiring harness cable (15)	Nut (12)	Remove from cable by sliding off toward end that connected to engine	
<u>INSTALLATION</u>			
5. Wiring harness cable (15)	Nut (12)	Slide on cable from engine connection end	Slide on cable all the way to plug end
6. Control box (8)	a Wiring harness cable (15)	Slide end of cable that connects to engine (one without plug) through large hole in bottom of control box. Go from inside control box toward outside	Use both hands. Work cable in short moves. Slide through until about 1-1/2 inches of heavy rubber cable is left in control box.
	b Fitting (16) removed in step 3h	Slide fitting, threads first, over cable starting from engine connection end until it seats in hole in control box	Fit through hole in control box until threads are visible inside box
	c Nut (12)	Screw on fitting (16)	Make sure all wires pass through nut

ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS (Continued)

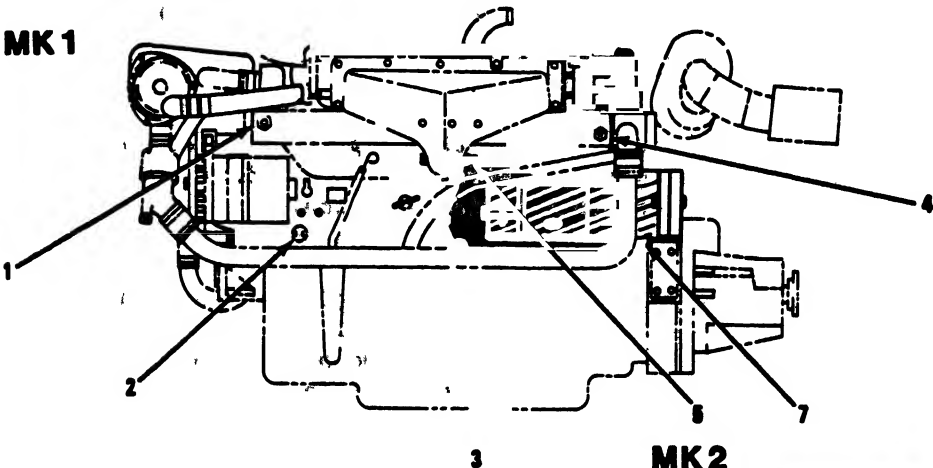
LOCATION	ITEM	ACTION	REMARKS
NOTE			
Before starting any connecting, look at the diagrams made when cable was removed. Use wiring diagram and wire reference index. If there is a question check wiring on other engine as guide.			
	d. Capacitor leads (11)	Connect leads and install washer and nut each location.	Make sure all wires pass through nut.
	e. Thermostart solenoid leads (10)	Connect leads and install washer and nut each of four locations.	
	f. Starter solenoid leads (9)	Connect leads and install washer and nut each of two locations	
	g. Receptacle securing screws (14)	Position receptacle and secure by installing four screws and nuts.	

NOTE

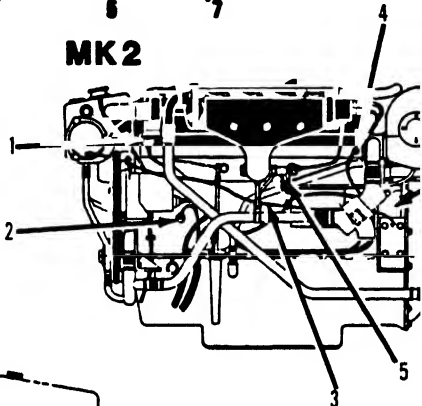
Refer to notes taken on cable routing before removal Use as guide to help properly route new cable.

ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS
(Continued)

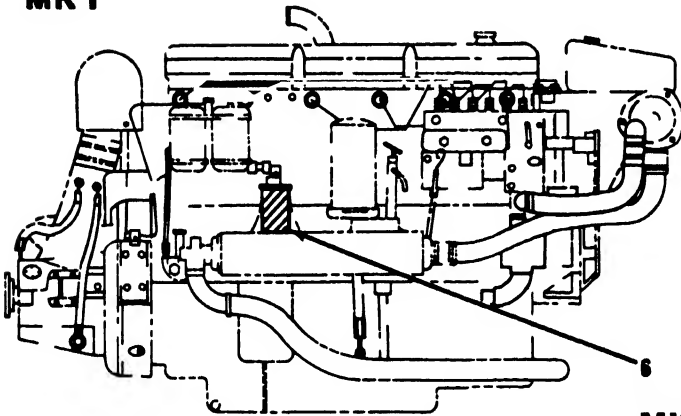
MK1



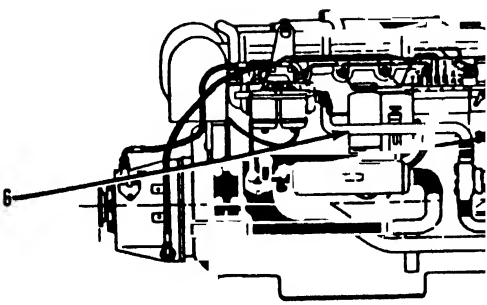
MK2



MK1



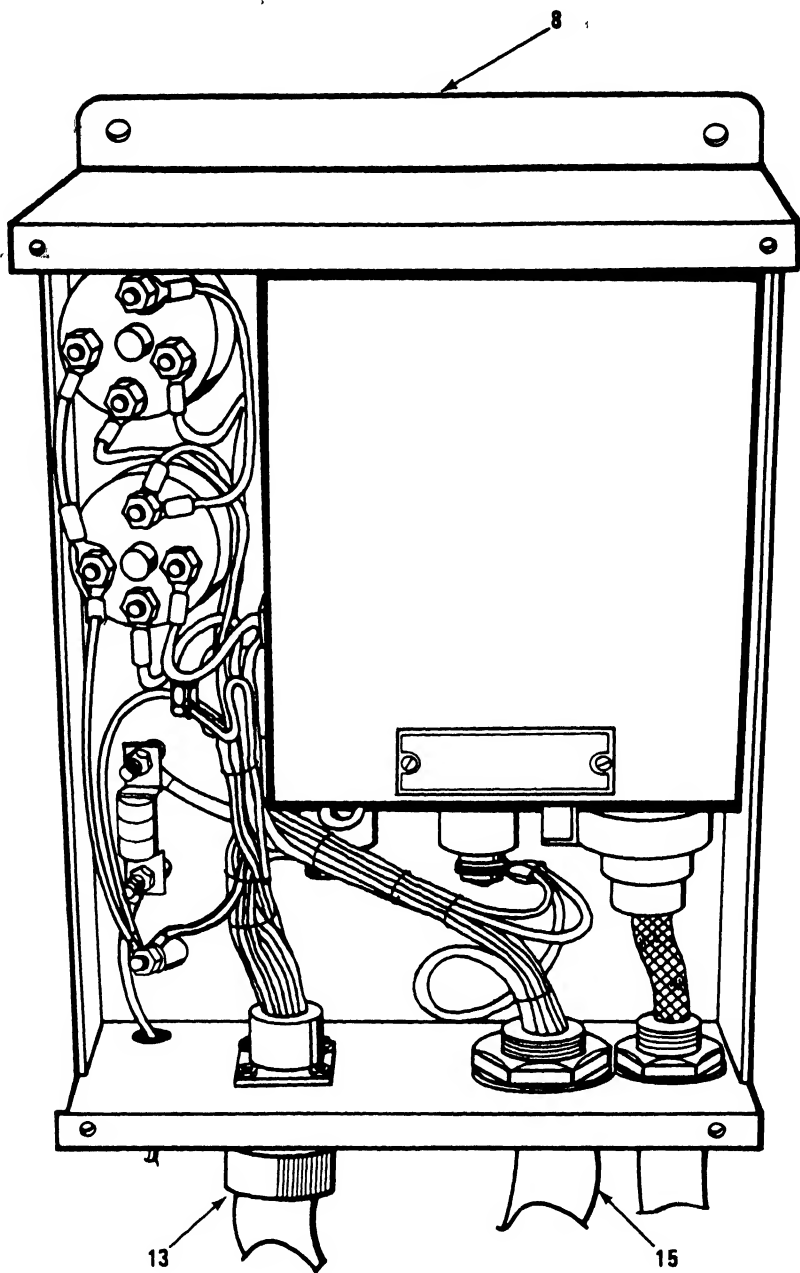
MK2



ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
7. Engine	a. Tachometer leads (6)	Connect	Ring terminals Use 7 mm socket
	b. Thermostart leads (5)	Connect	Push on terminals
	c. High temperature sending leads (4)	Connect.	Push on terminals
	d. Low oil pressure leads (3)	Connect.	Push on terminals
	e. Oil pressure sending leads (2)	Connect.	Ring terminals Use 7 mm socket
	f. Water temperature sending leads (1)	Connect	Push on terminals
8 Starter (7)	a. Three small leads to R- (negative) terminal	Connect	Use 1/2 in socket
	b. Two small leads to B+ (positive) terminal	Connect	Use 1/2 in socket
	c. Lead to small S terminal	Connect	Use 8 mm socket
	d. Two small leads to small R terminal	Connect	Use 8 mm socket

ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE WIRING HARNESS REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
9. Control box (8)	Connecting cable (13), control box to console	Connect socket on cable to plug in control box and secure with retaining ring on socket.	Socket and plug are keyed and can fit only in one position
10. Wiring harness cable (15)	Cable ties	Secure installed cable using ties spaced as required	

NOTE

FOLLOW ON MAINTENANCE PROCEDURE Connect batteries and close engine hatches (reference TM 5-1940-277-20)



ENGINE WIRING HARNESS AND INTERCONNECT HARNESS REPAIR INSTRUCTIONS

This task covers

- a. Inspection
- b. Repair

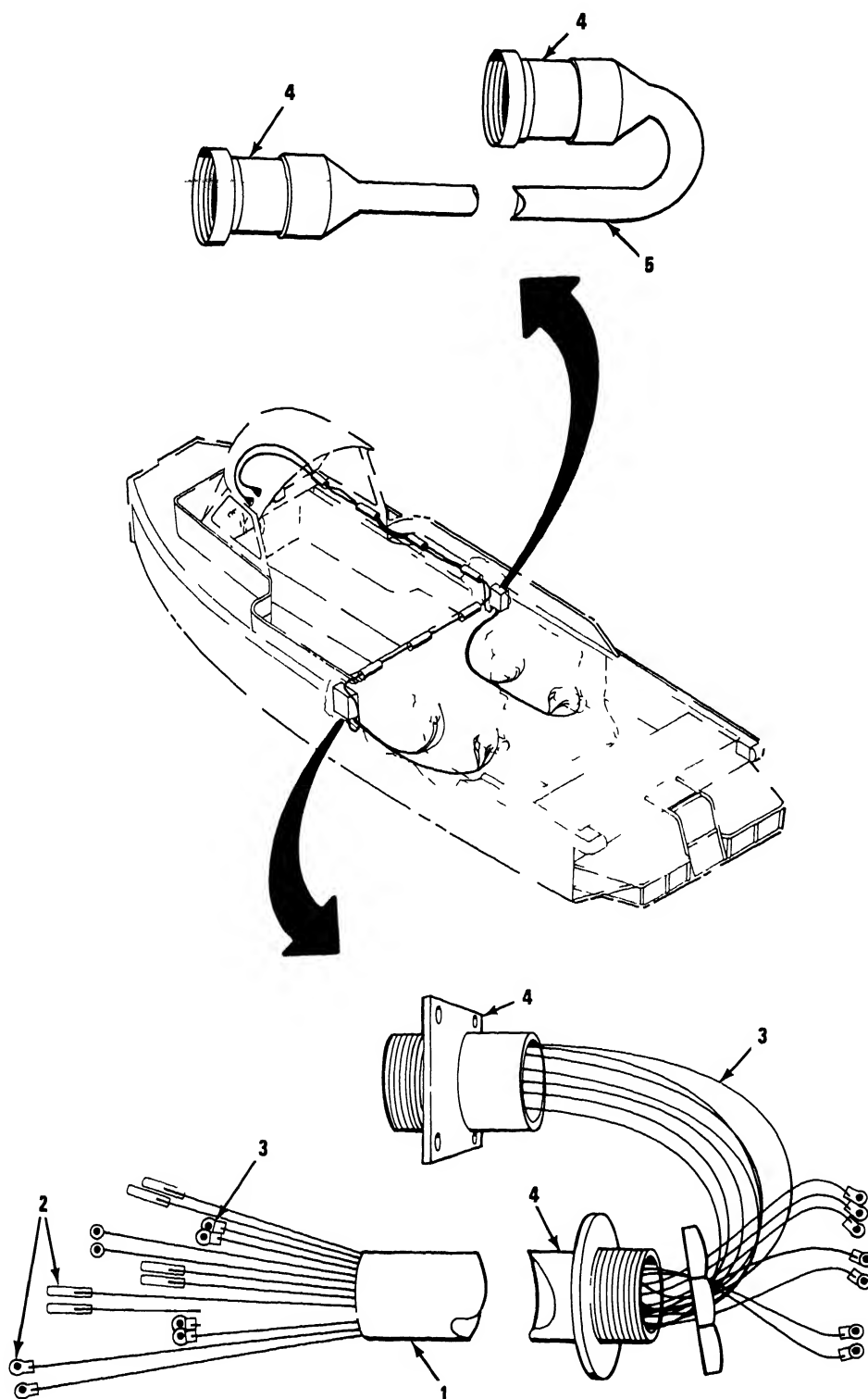
INITIAL SETUP

Tools	Equipment Condition	Condition Description
Wire stripper	TM 5-1940-277-20	Engine hatches open.
Crimper	TM 5-1940-277-20	Control box cover removed.
Diagonal pliers		
Multimeter	TM 5-1940-277-20	Storage compartment open.
Soldering iron		
Long nose pliers		

Materials/Parts

- Push on connectors
- Ring terminal connectors
- Butt connectors
- Connector plugs
- Solder, rosin core

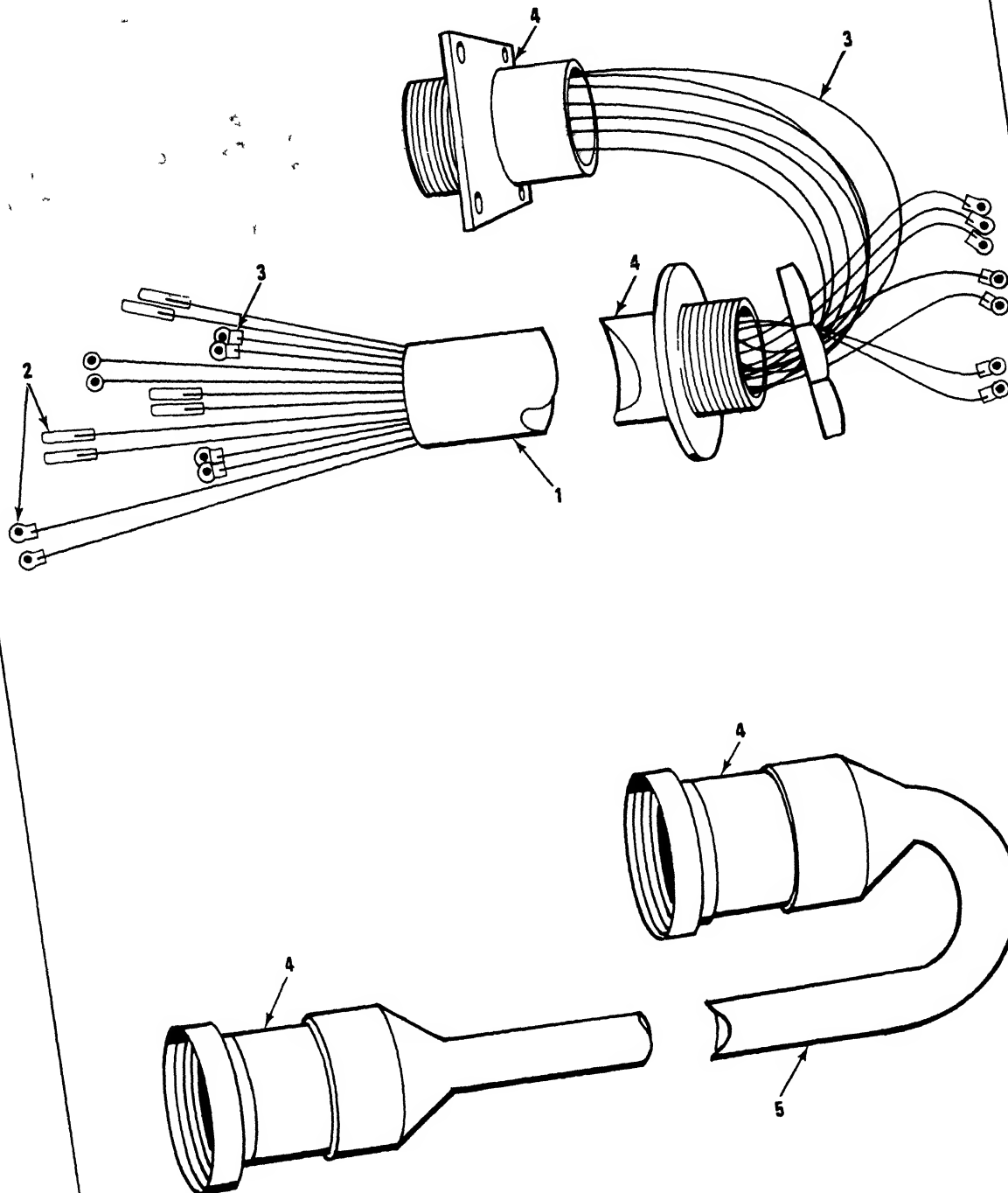
ENGINE WIRING HARNESS AND INTERCONNECT HARNESS REPAIR INSTRUCTIONS
(Continued)



ENGINE WIRING HARNESS AND INTERCONNECT HARNESS REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>INSPECTION</u>			
1.	Engine wiring harness (1) and interconnect harness (5)	Visually inspect wiring harness for broken or damaged connections, broken wires or frayed or cracked insulation.	Use wiring diagram. Repair broken connections and wire. If insulation is damaged replace cable
<u>REPAIR</u>			
2	Engine wiring harness (1) and interconnect harness (5)	a. Broken connection Remove old connector (2) by pulling off or removing nut and washer as required. If wire end frayed cut square. Strip about 1/4 in of insulation from wire. Select correct replacement connector (same as one removed) and fit to wire. Crimp connector to wire. Connect wire to terminal	Use pliers, wire stripper and crimper. Cut only enough wire to square up end

ENGINE WIRING HARNESS AND INTERCONNECT HARNESS REPAIR INSTRUCTIONS
(Continued)



ENGINE WIRING HARNESS AND INTERCONNECT HARNESS REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	b. Broken wire (3)	If wire is frayed cut ends square. Strip about 1/4 in from each wire end. Fit each stripped wire end into butt connector. Crimp butt connector to each wire end.	Use pliers, wire stripper and crimper. Cut only enough wire to square up ends.
	c. Broken wire, section missing	Replace cable	
	d. Broken connector plug (4)	Replace cable	

1-2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

ENGINE WIRING INTERCONNECT HARNESS REPLACEMENT INSTRUCTIONS

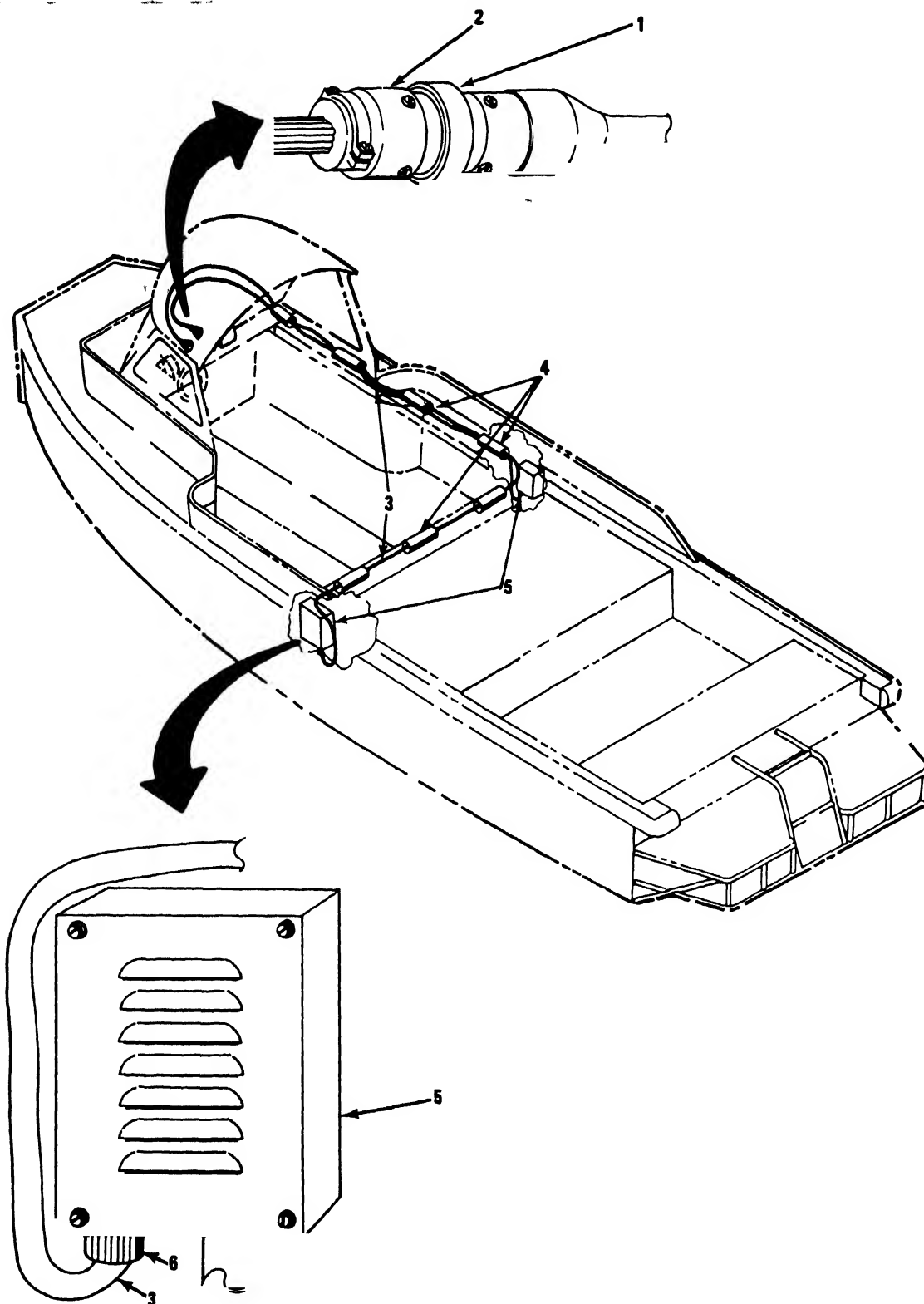
This task covers

- a Removal
- b Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Flat tip screwdriver	TM 5-1940-277-20	Battery disconnected
Diagonal cutting pliers	TM 5-1940-277-20	Control console access hatch open
Soldering iron	TM 5-1940-277-20	Storage compartment open
Materials/Parts	TM 5-1940-277-20	Wiring diagram for wire identification
Engine wiring interconnect harness with plug and receptacle		
Tape, electric plastic		
Cord (30 ft)		

ENGINE WIRING INTERCONNECT HARNESS REPLACEMENT INSTRUCTIONS (Continued)

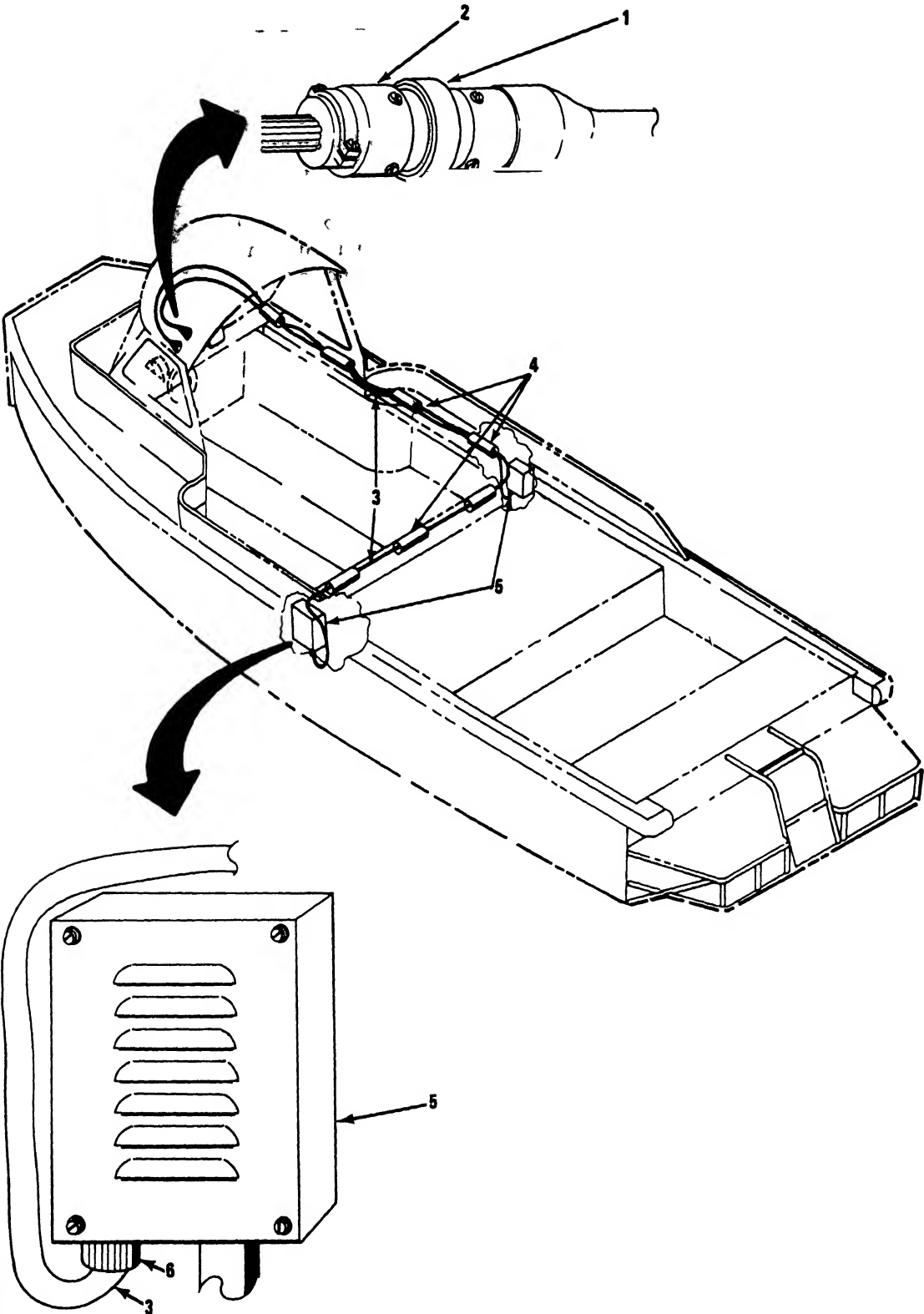


ENGINE WIRING INTERCONNECT HARNESS REPLACEMENT INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1	Control console	a. Harness connector (1)	a. Disconnect by use hands unscrewing retaining ring on plug (2) and pulling plug from receptacle.
		b. Fasten cord to end of harness	Tie and tape cord for use in replacing new harness
NOTE			
Carefully feed cord as harness is being removed			
2	Battery compartment	Interconnect harness (3)	Pull harness out of support tubes (4) welded on starboard side of boat
			Pull harness by hand aft from starboard side of battery compartment
3	Control box (5)	Connector plug (6)	Disconnect by unscrewing retaining ring on plug and pulling down on plug
			Use hands
<u>INSTALLATION</u>			
4	Battery compartment	Harness connector receptacle (1)	a. Fasten cord to harness
			Tie and tape cord to harness.

ENGINE WIRING INTERCONNECT HARNESS REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE WIRING INTERCONNECT HARNESS REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
NOTE			
Carefully feed harness through supports as cord is being pulled			
		b. Route harness from battery compartment along star-board side to control console	Keep harness straight and feed by hand through support tubes welded on star-board side of boat while pulling at same time on cord.
5. Control box	Connector plug (6)	Connect plug to receptacle on bottom of control box.	Push plug into receptacle and hand tighten retaining ring on plug.
NOTE			
Wire identification and pin callout are contained on the wiring diagram.			
6 Control console	Harness connector (1)	Connect plug to receptacle on interconnect harness by screwing on retainer ring	Use hands to turn retainer ring

MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - LOWER

This task covers

- a. Removal
- b. Installation

INITIAL SETUP

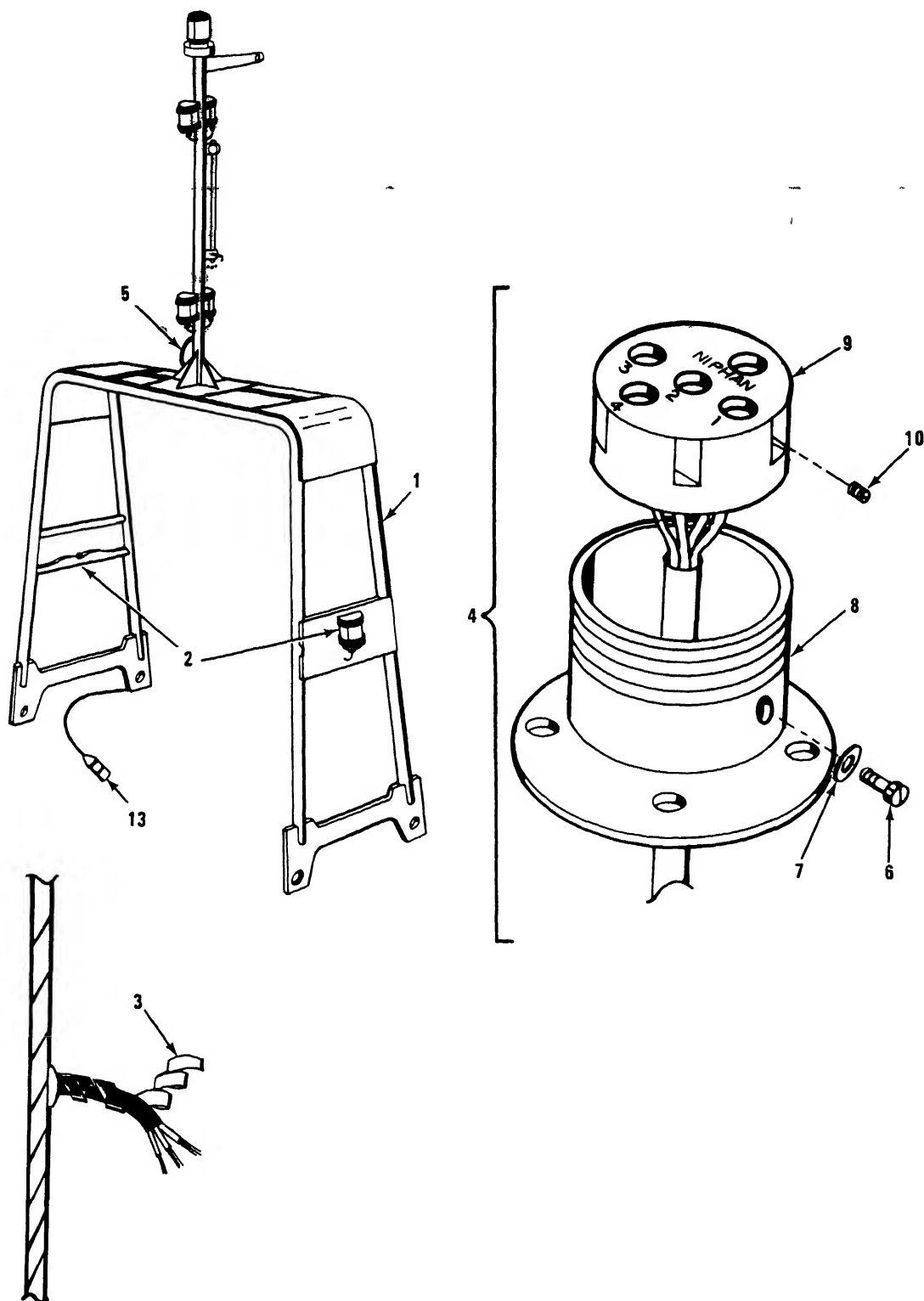
Tools	Equipment Condition	Condition Description
Flat tip screwdriver (small)	TM 5-1940-277-20	Mast removed.
Knife		

Materials/Parts

Mast wiring harness with plug
Rubber grommets
Cord (90 feet)

Personnel Required Three

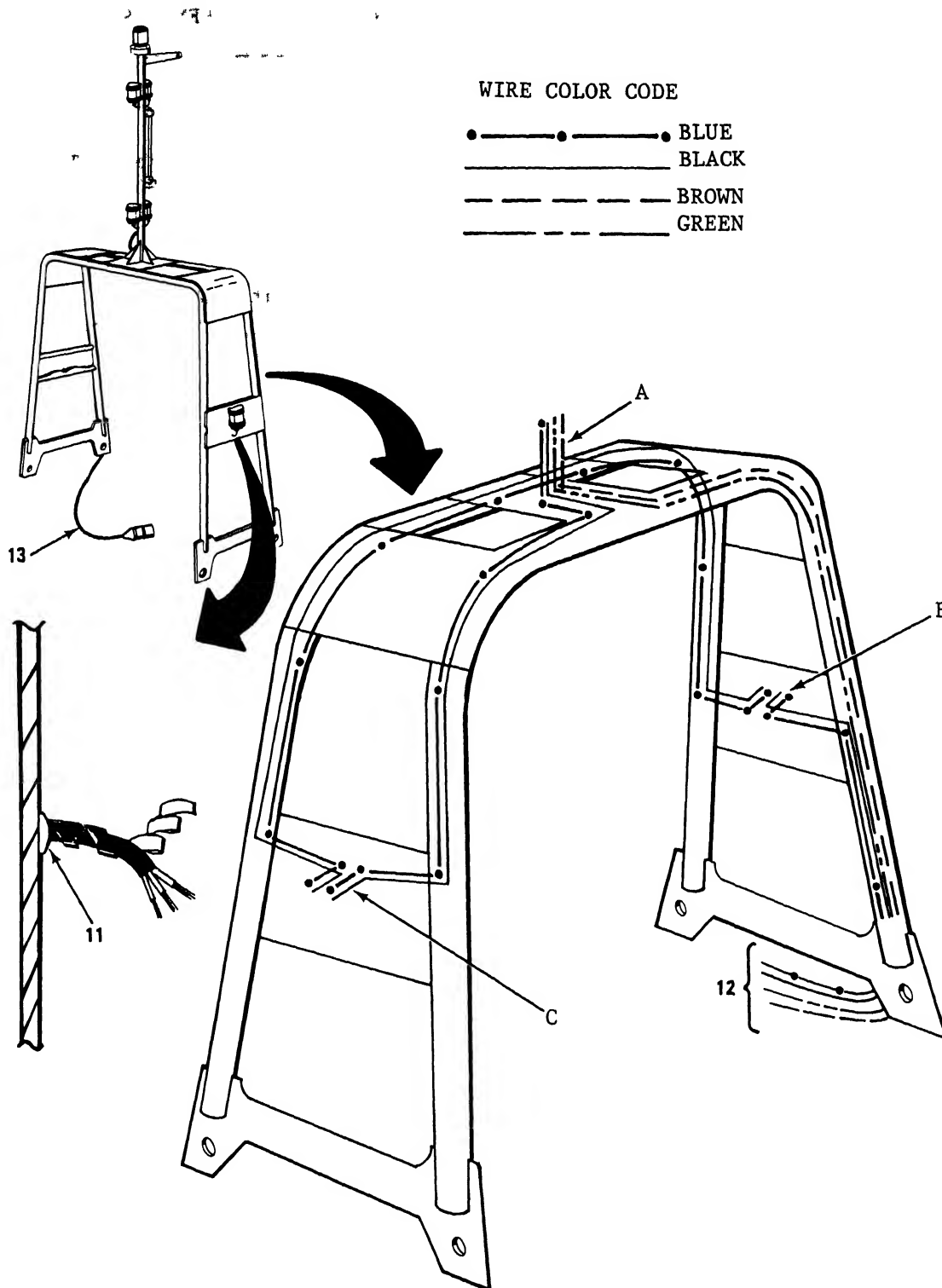
MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - LOWER
(Continued)



MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - LOWER (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1	Lower mast (1)	a. Light sockets (2) (navigation)	Remove Reference TM 5-1940-277-20
		b. Spiral wrap (3) on wires	Remove all that is exposed. Wraps around wire Unwind and retain.
		c. Socket (4) and plug (5)	Unscrew plug from socket Disconnects upper mast harness from lower mast harness
		d. Socket retaining screw (6) and washer (7)	Remove screw from side of socket housing (8) Use screwdriver Frees socket to be pulled out of housing
		e. Socket core (9)	Pull out of socket housing (8)
NOTE			
Before next step check wire color leading to each pin Pin numbers are on face of socket and should be 1 - Blue, 2 - Black, 3 - Brown, 4 - Green If not, make diagram of connections			
	f. 4 wire retaining screws (10)	Loosen and pull wires out	Use screwdriver Lay core aside for reuse
NOTE			
Next step applies to point where wires enter mast frame.			

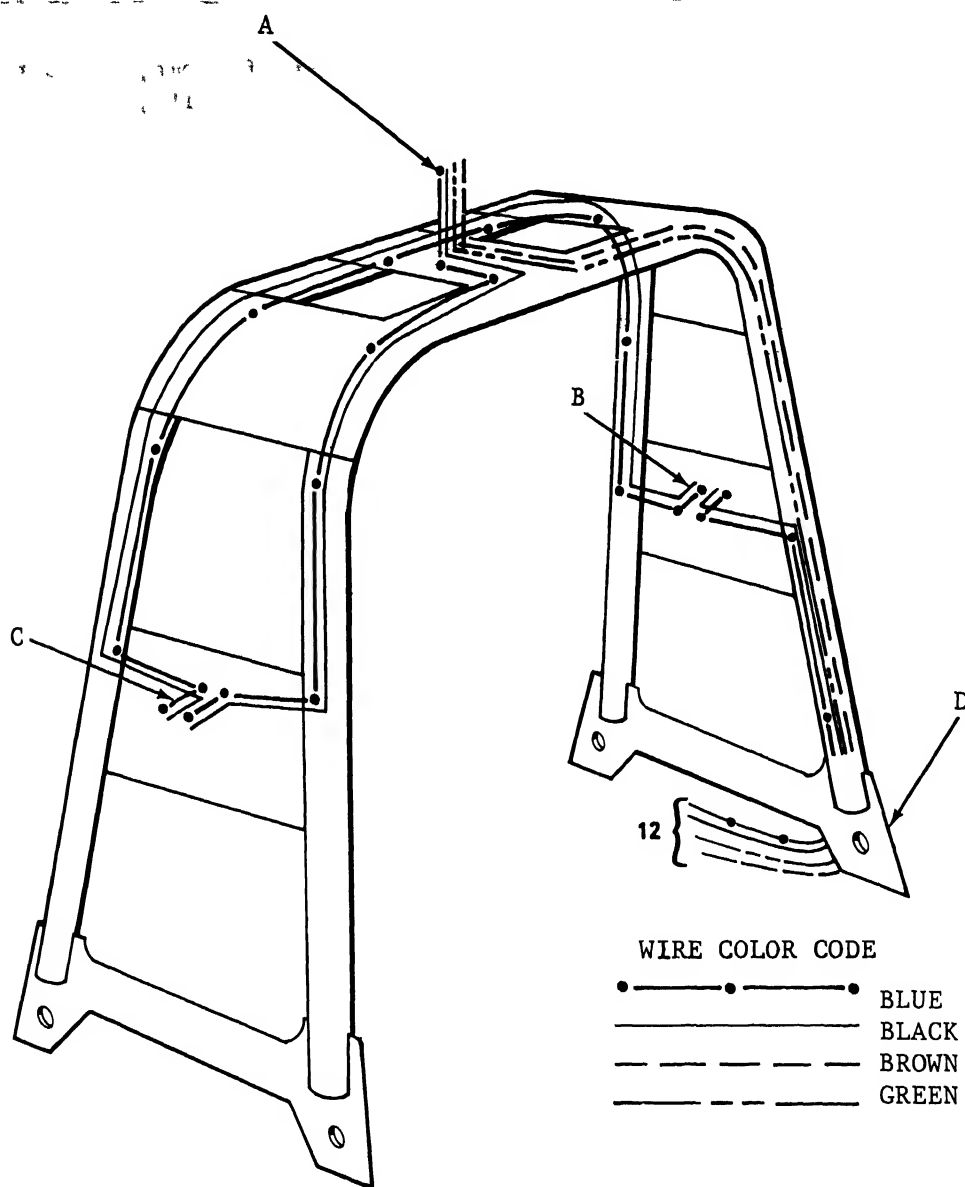
MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - LOWER
(Continued)



MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - LOWER (Continued)

LOCATION	ITEM	ACTION	REMARKS
	g. 7 rubber grommets (11)	Pry out of frame, Use screwdriver split with knife, remove and discard	
<p style="text-align: center;">NOTE</p> <p>Next step applies to old harness as installed. The wiring harness consists of three separate segments of wires</p>			
	h. Wiring harness (12) at point A	<p>a Tie cord to end of brown and green wires.</p> <p>b Tie a second cord to end of blue and black wires</p>	
	i Wiring harness (12) at point B	<p>a Tie one cord to end of one pair blue and black wires leading to plug (13)</p> <p>b Tie second cord to second pair of blue and black wires leading to point C</p>	

MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - LOWER
(Continued)



MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - LOWER (Continued)

LOCATION	ITEM	ACTION	REMARKS
	j Wiring harness (12) at point C	Grasp in turn one pair of black and blue wires leading from a Point B b. Point A and pull wiring out of mast frame.	Cord will be pulled through mast as old harness is removed
	k. Wiring harness (12) at point D	Grasp plug and pull wiring out of mast frame at point D	Cord will be pulled through mast as old harness is removed
	l Cord	Tag cords pulled through mast frame by wire colors and points (A or B) to which cord leads	

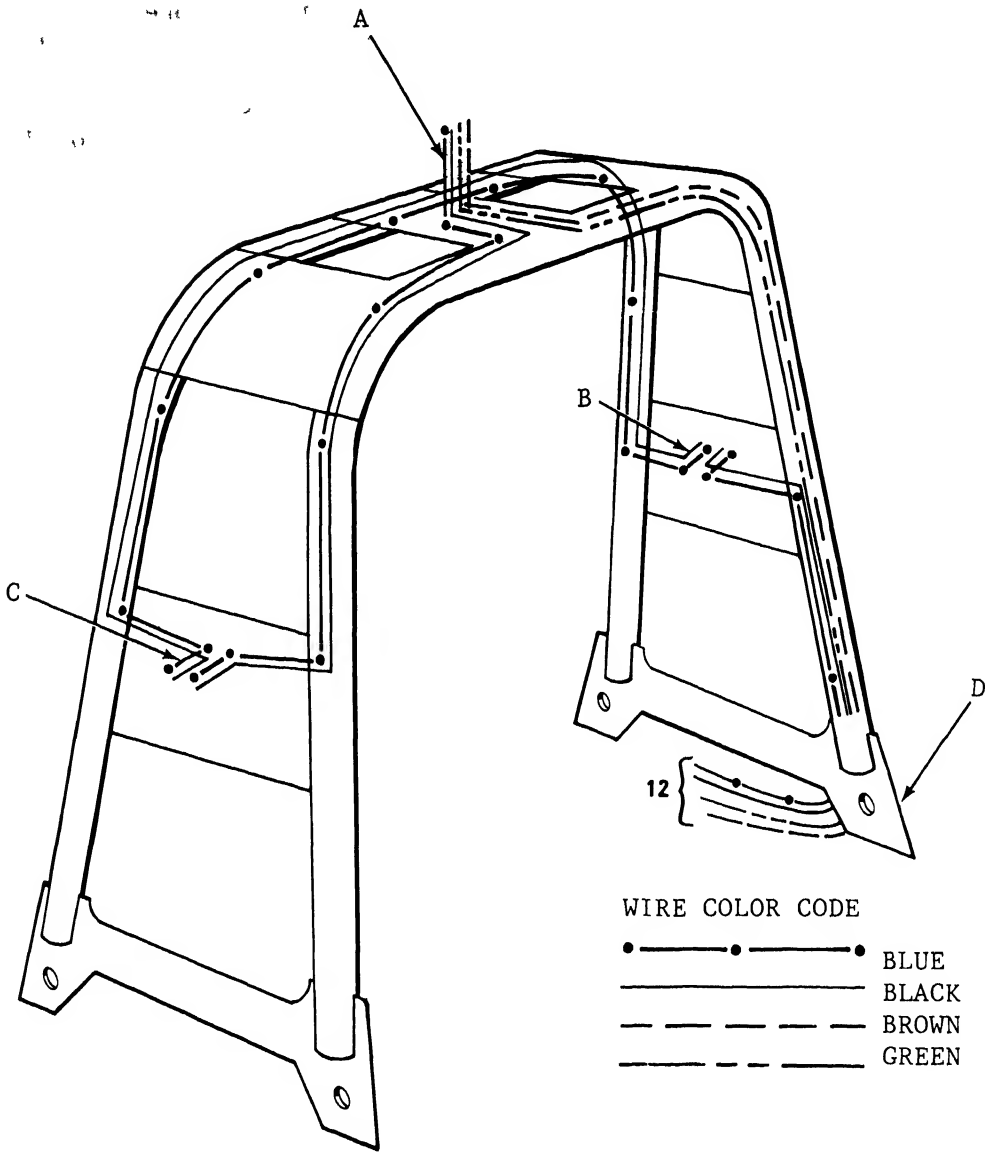
INSTALLATION

NOTE

Before next step lay new harness out and cut individual segments of new harness equal to old harness segments

- | | |
|---------------------------|---|
| m Wiring harness segments | Tie segments to correct cords (note tags) |
|---------------------------|---|

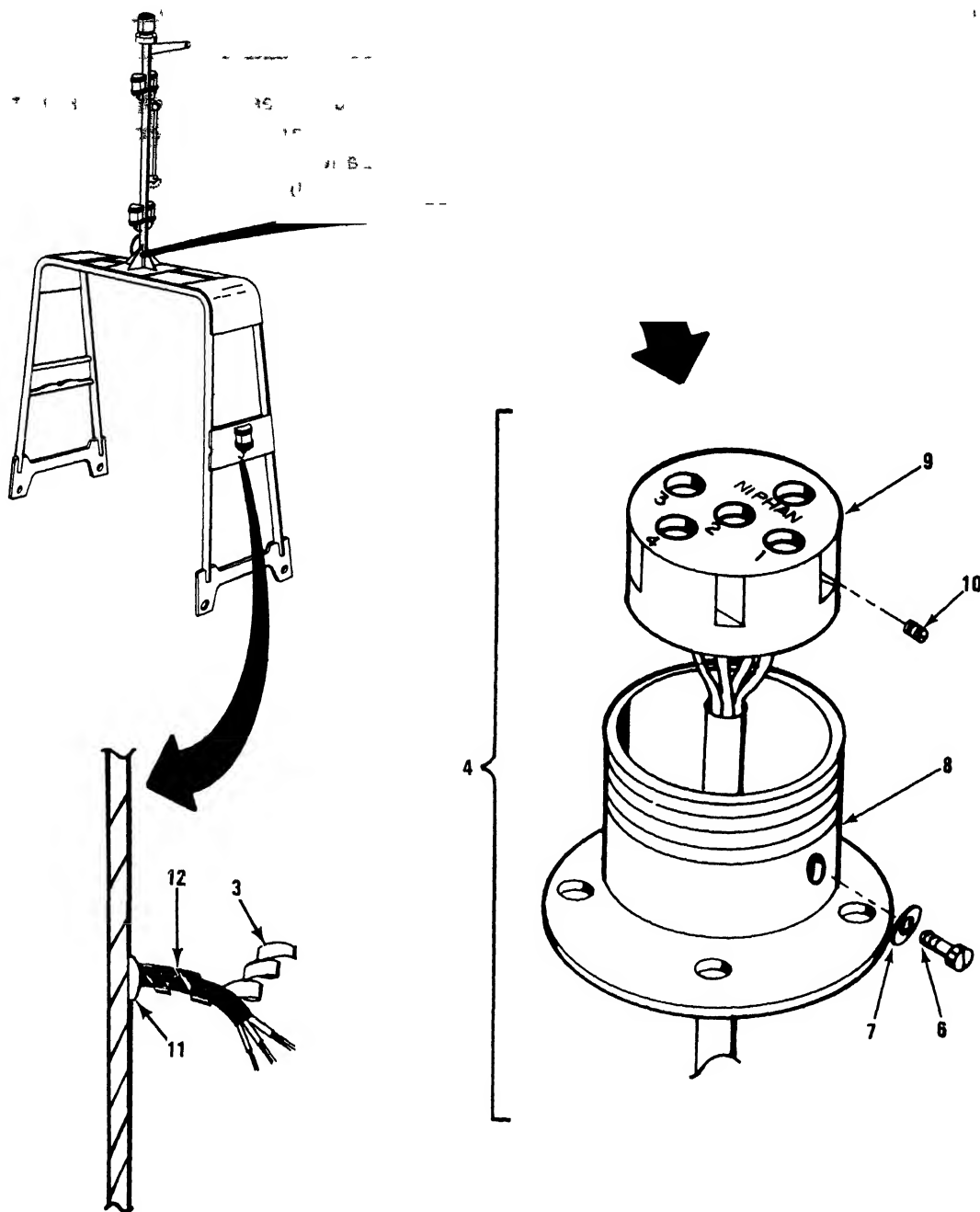
MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - LOWER
(Continued)



MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - LOWER (Continued)

LOCATION	ITEM	ACTION	REMARKS
	n. Wiring harness (12) attach to plug (13)	<p>a. Feed wires into mast frame at point D.</p> <p>b. Pull cords attached to wires at points A and B at same time until wire pairs are in position.</p> <p>c. Remove cord when wires in position</p>	Requires three persons.
	o. Wiring harness (12) - blue and black wire pairs at point C	<p>a. Pull on cord at point A and at same time feed wire pair into mast frame at point C until wire is in position</p> <p>b. Pull on cord at point A and at same time feed second wire pair in mast frame at point C until wires are in position.</p> <p>c. Remove cords when wire pairs in position</p>	

MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - LOWER
(Continued)



MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - LOWER
(Continued)

LOCATION	ITEM	ACTION	REMARKS										
	p. Wiring harness (12) at points A, B and C and 7 rubber grommets (11)	a Feed wires through rubber grommets. b Install grommets in opening in mast frame											
	q Spiral wrap (3)	Install on exposed portions of wires at point A, B and C											
	r Socket core (9) and 4 retaining screws (10)	a Connect 4 wires to correct pin <table><tr><th>Pin</th><th>Wire</th></tr><tr><td>1</td><td>Blue</td></tr><tr><td>2</td><td>Black</td></tr><tr><td>3</td><td>Brown</td></tr><tr><td>4</td><td>Green</td></tr></table> b Seat in socket housing (8)	Pin	Wire	1	Blue	2	Black	3	Brown	4	Green	
Pin	Wire												
1	Blue												
2	Black												
3	Brown												
4	Green												
	s Socket retaining screw (6) and washer (7)	Install socket retaining screw in side of housing											
	t Lights (2) (navigation)	Install	Reference TM 5-1940-277-20										

—

2000

—

—

—

MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER

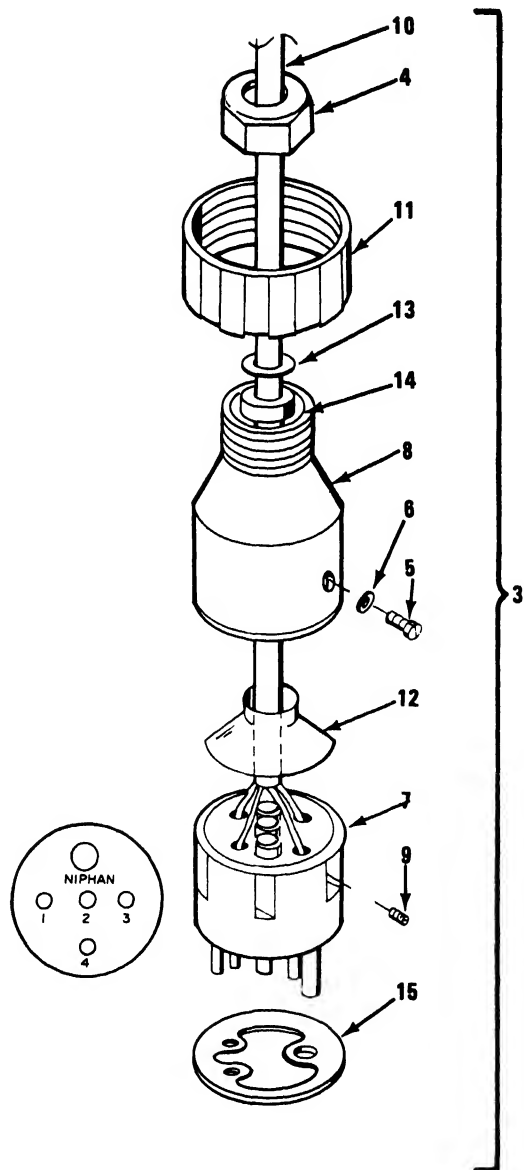
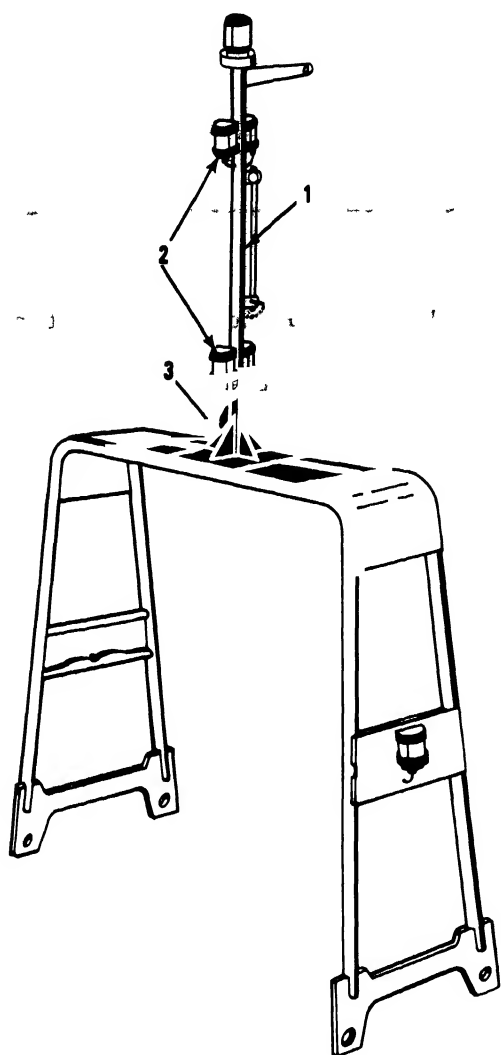
This task covers

- a Removal
- b Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Flat tip screwdriver (small)	TM 5-1940-277-20	Mast removed
Pliers		
7/8 in box/open wrench		
Wire stripper		
Knife		
Materials/Parts		
Wiring harness		
Cord (50 foot)		
Waterproof sealing compound		
Personnel Required	Two	

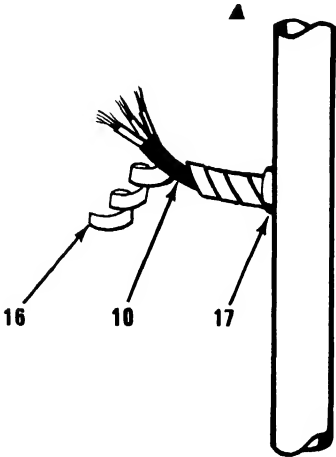
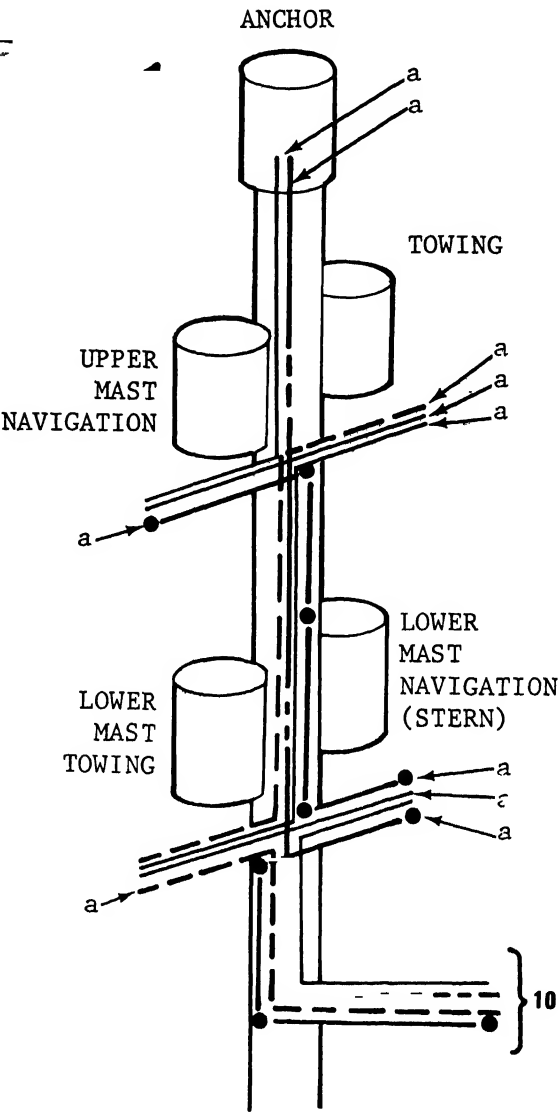
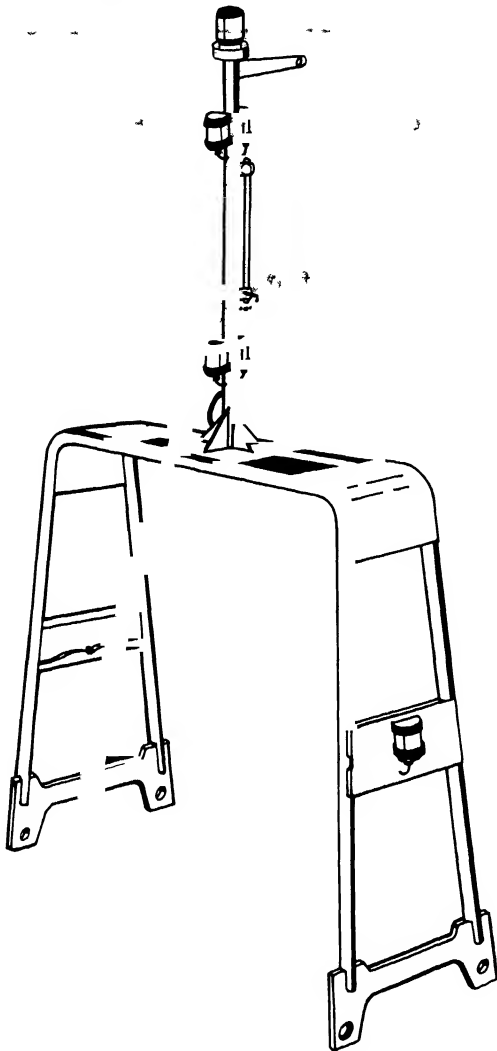
MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER
(Continued)



MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1. Mast (1) (upper section)	a. Light sockets (2), navigation, anchor)	Remove	Reference TM 5-1940-277-20.
	b Plug (3)	Unscrew from socket	
2. Plug (3)	a. Plug nut (4)	Remove.	Use 7/8 in wrench.
	b. Plug retaining screw (5) and washer (6)	Remove.	Use screwdriver.
	c Plug core (7)	Pull out of plug case (8).	
NOTE			
Before next step draw diagram of wire color to pin number connections Pin numbers are on plug face			
	d 4 wire retaining screws (9) and wire harness (10)	a. Loosen screws	Use screwdriver
		b Pull wires out of plug core (7)	Retain plug core for installation on new harness.
	e. Plug nut (4), retaining nut (11), plug case (8), plastic shield (12), washer (13), rubber grommet (14) and washer (15)	Remove and retain to be reused	

MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER
(Continued)

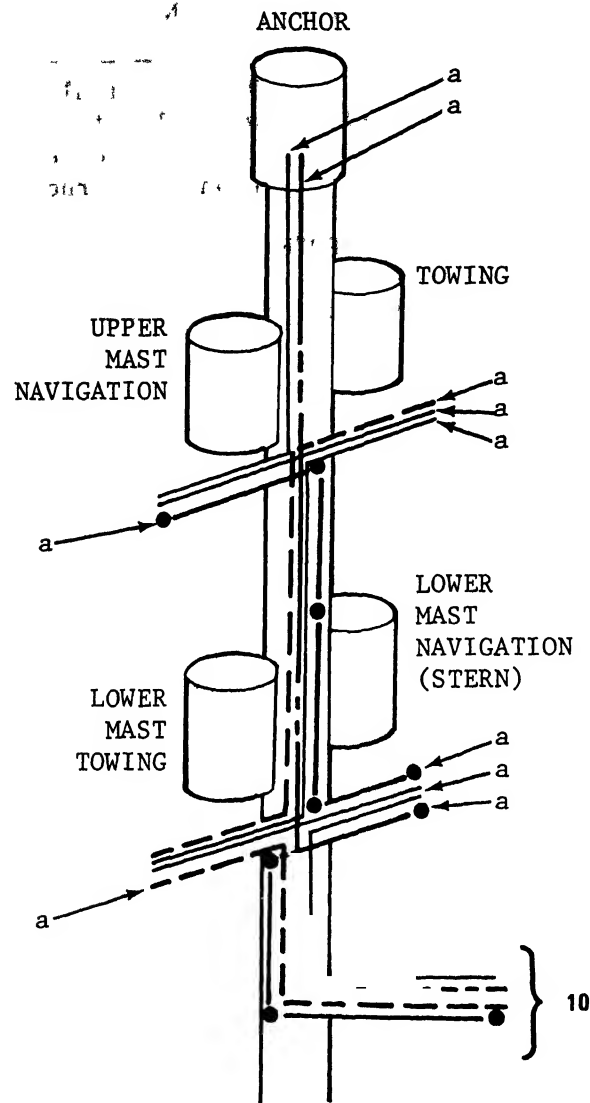


WIRE COLOR CODE			
●	—	●	BLUE
—			BLACK
- - -			BROWN
- - -			GREEN

MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER (Continued)

LOCATION	ITEM	ACTION	REMARKS
	f. Wiring harness (10)	Remove spiral wrap (16) from all exposed sections of harness.	Unwind from wire Retain for reuse.
NOTE			
Next step involves items located at points wires enter and exit mast section.			
	g. 5 grommets (17)	a. Pry out of mast	Use screwdriver.
		b. Cut off wires	Use knife.
		c. Discard	
	h. Wiring harness (10)	a. Tie a cord to each wire indicated in figure with a	
		b. Start with upper navigation light wires and working way down mast to lower light positions, pull each wire without an attached cord out of mast frame with attached cord. Carefully feeding other end of wire being pulled into mast frame	Stop pulling when each cord has been pulled through mast

MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER
(Continued)



WIRE COLOR CODE

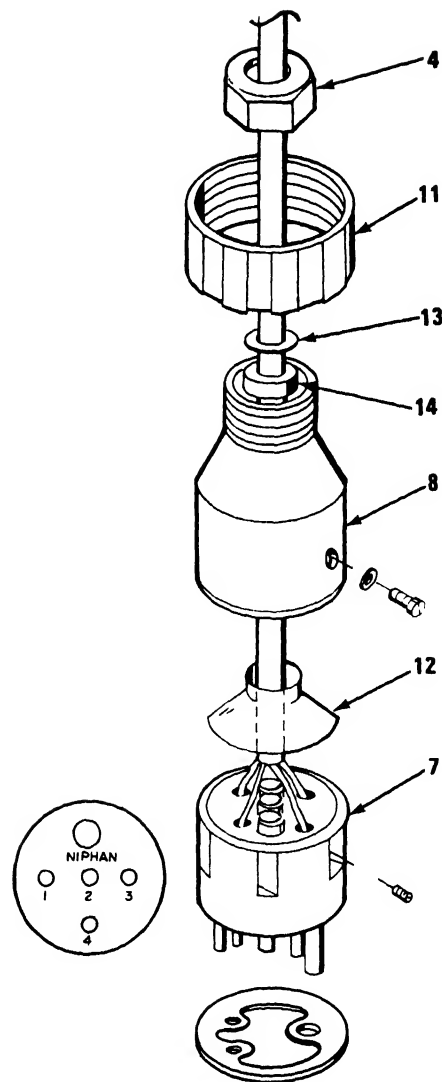
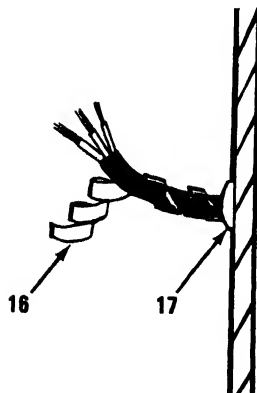
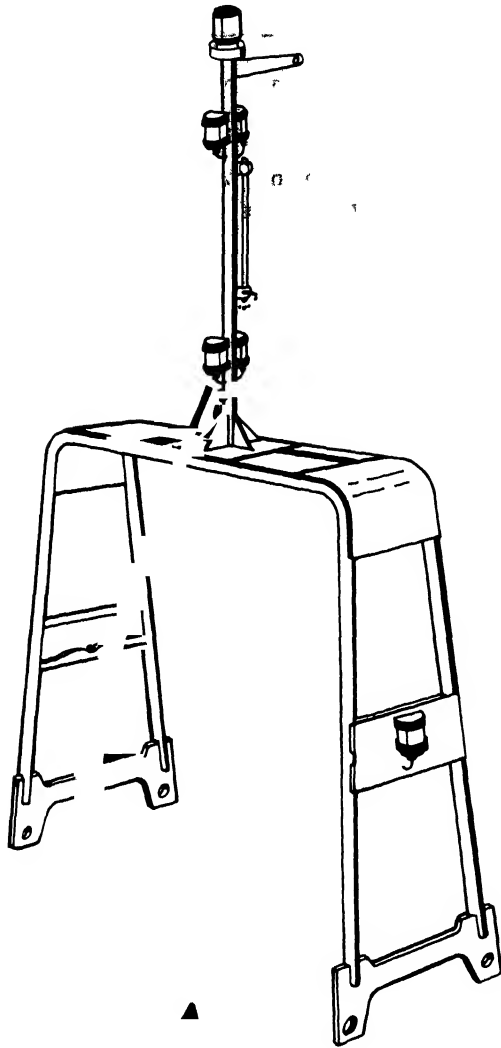
● ——— ● ——— ●	BLUE
—————	BLACK
- - - - -	BROWN
· · · · ·	GREEN

MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER

(Continued)

LOCATION	ITEM	ACTION	REMARKS
		c	Tag both ends of each cord by wire color and the positions on mast it passes between.
		d	Carefully tag each wire segment pulled from frame to note the points of entry and exit from mast frame
<u>INSTALLATION</u>			
	i Wiring harness (10)	a	Cut new wire segments, make sure wires are correct color and length
		b	Use old wire segments as patterns to cut new segments
			As each new wire segment is cut, transfer tag from old wire to new wire

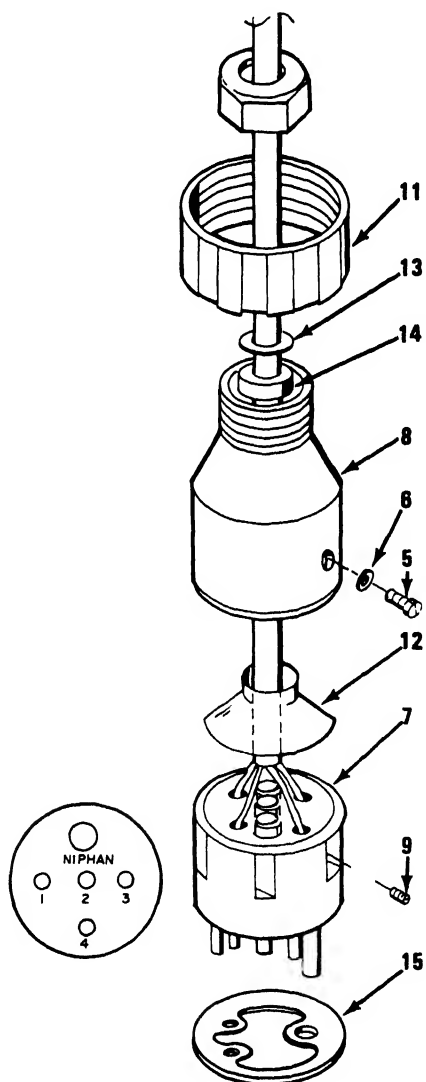
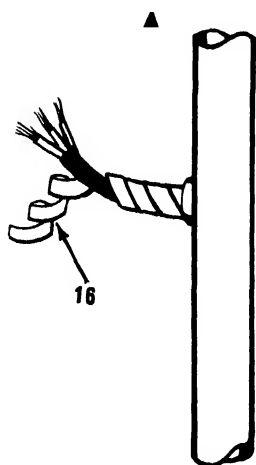
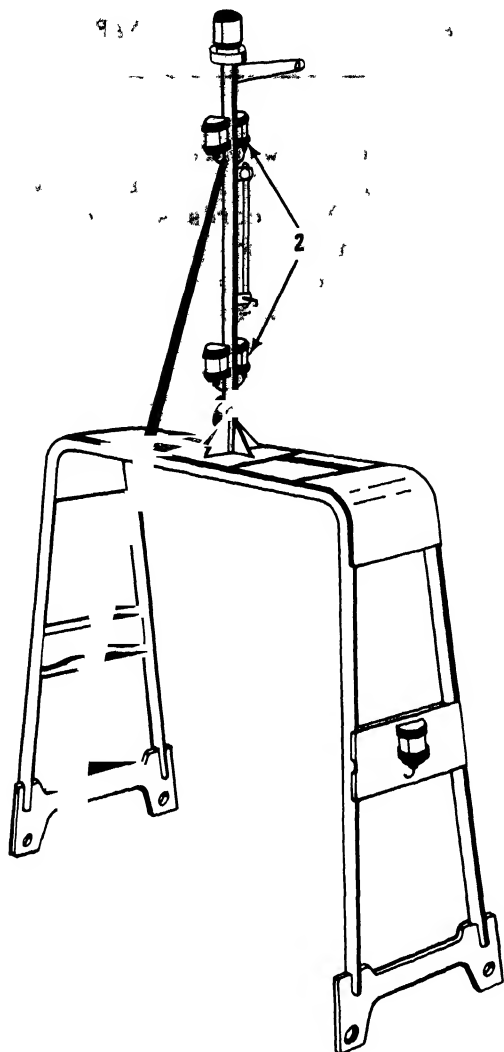
MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER
(Continued)



MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER (Continued)

LOCATION	ITEM	ACTION	REMARKS
		c. Match new wire segments (ID tags) to cords on mast and tie cords to ends of wires	Test knot to make sure it will not slip off
		d. Carefully feed wires, one at a time, into mast holes while pulling on cord tied to other end to guide wire into mast frame at same time	Use two persons, one feeding wire and one pulling on cord.
		e. Remove cords when wire segments have been pulled through mast frame	
	j. 5 grommets (17)	a. Feed wires at mast holes through grommets	
		b. Install grommets into mast holes to seal openings	
	k. Plug nut (4), washer (13), rubber grommet (14), retaining nut (11), plug case (8) and plastic shield (12)	a. Fit in sequence on lower end of wiring harness	
		b. Strip 1/2 inch insulation from ends of wires	

MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER
(Continued)



MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER (Continued)

LOCATION	ITEM	ACTION	REMARKS										
	1. Plug core (7)	a. Fit wires into correct pins to match color coding	<table><tr><th>Pin</th><th>Wire</th></tr><tr><td>1</td><td>Blue</td></tr><tr><td>2</td><td>Black</td></tr><tr><td>3</td><td>Brown</td></tr><tr><td>4</td><td>Green</td></tr></table>	Pin	Wire	1	Blue	2	Black	3	Brown	4	Green
Pin	Wire												
1	Blue												
2	Black												
3	Brown												
4	Green												
		b. Install screws (9) securing wires.											
	m. Plastic shield (12)	a. Slide down onto plug core (7).											
		b. Seal throat of shield with sealant.	Use silicone sealant										
	n Plug case (8)	Slide down over plug core (7)											
	o Retaining ring (11)	Slide down over plug case (8)											
	p Plug core retaining screw (5) and washer (6)	Install securing plug core in case	Retaining ring (11) must be below retaining screw (5) hole in plug case (8) before installing screw										
	q Washer (13) and rubber grommet (14)	Slide down wires into throat of plug case (8)											
	r Plug nut (4)	Screw onto plug case (8)											

MAST WIRING HARNESS REPLACEMENT INSTRUCTIONS - UPPER
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	s. Spiral wrap (16)	Install on exposed wire sections.	
	t Lights (2) (anchor, navi- gation, towing)	Install	Reference TM 5-1940-277-20

CONTROL BOX REPLACEMENT INSTRUCTIONS

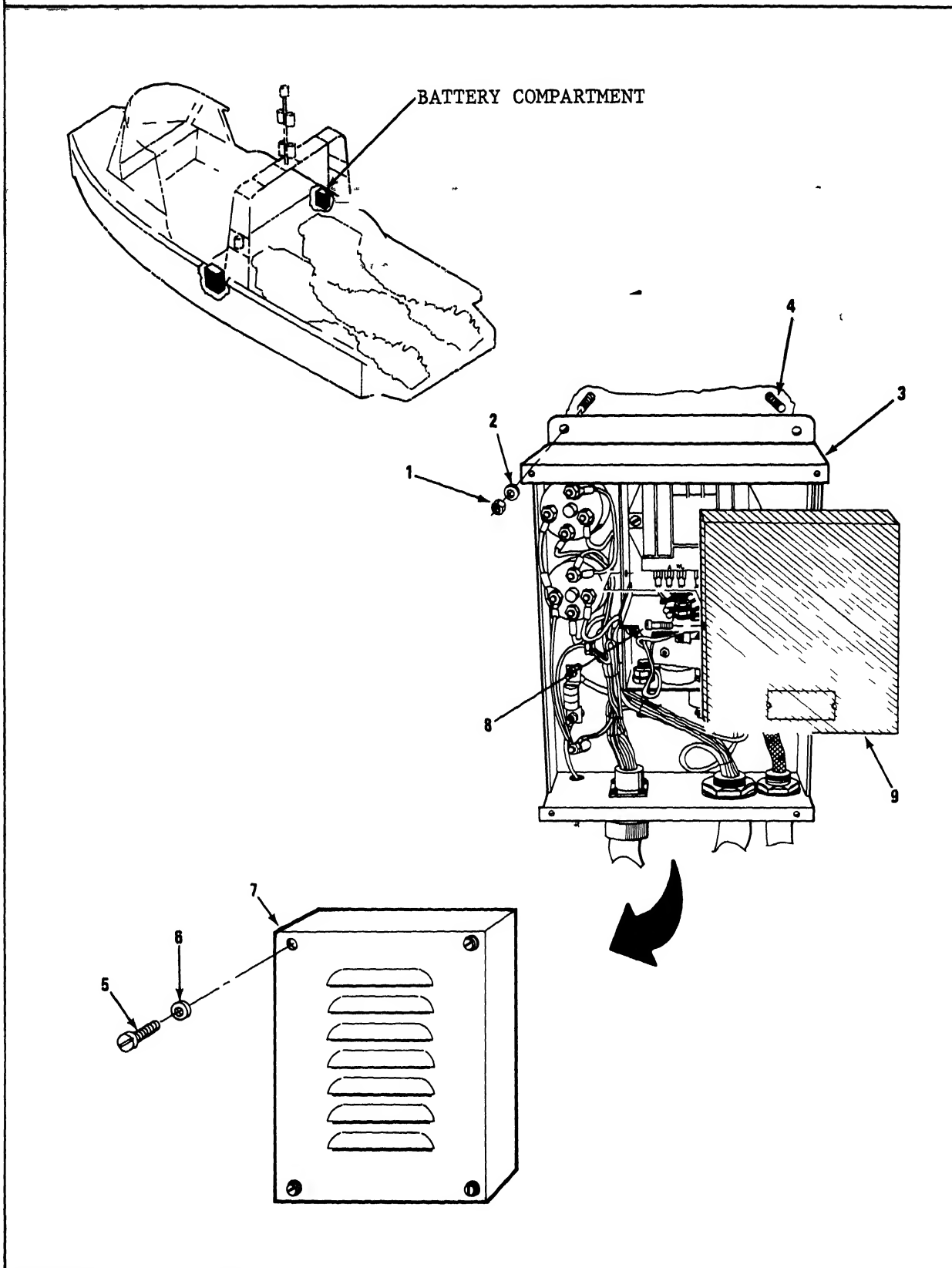
This task covers

- a. Removal
- b. Replacement

INITIAL SETUP

Tools	Equipment Condition	Condition Description
10 mm socket	TM 5-1940-277-20	Engine compartment hatch open.
Extension		
Ratchet	TM 5-1940-277-20	Battery compartment hatch open.
Flat tip screwdriver		
Materials/Parts	Page 2-93	Engine wiring harness disconnected at engine.
Control box		
10 mm open end wrench		
13 mm open end wrench		
Channel lock pliers		

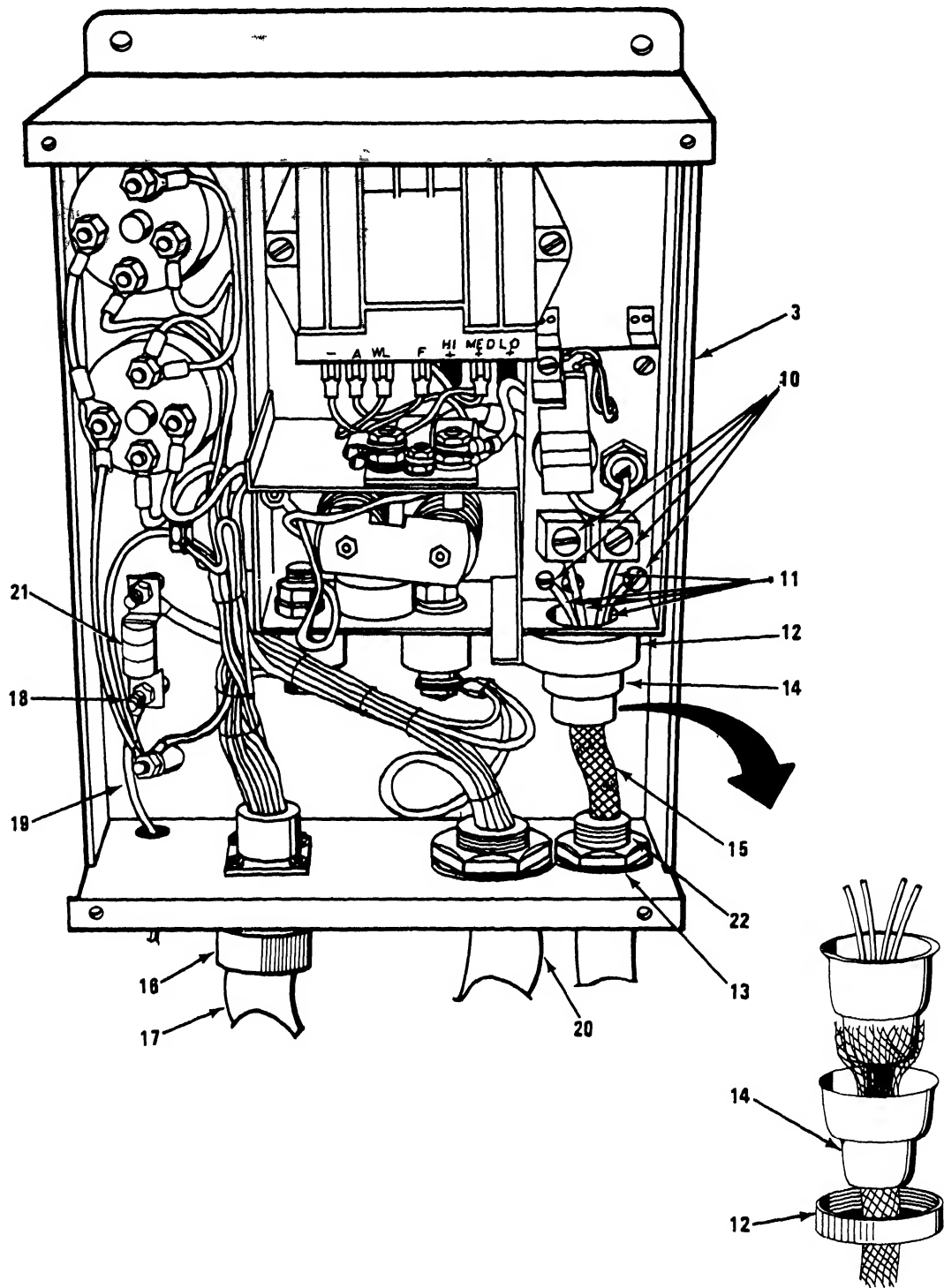
CONTROL BOX REPLACEMENT INSTRUCTIONS
(Continued)



CONTROL BOX REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1. Battery compartment	Control box (3)	<p>a. Remove four nuts (1) and four washers (2).</p> <p>b. Pull control box (3) off four studs (4) and place on top of battery covers.</p> <p>c. Remove four screws (5), four washers (6) and control box cover (7)</p> <p>d. Remove two screws (8) and voltage regulator box cover (9)</p>	<p>Use 10 mm socket with extension. Use 10 mm open end wrench</p> <p>The control box is easier to work on in this position.</p> <p>Use flat tip screwdriver</p> <p>Use flat tip screwdriver</p>

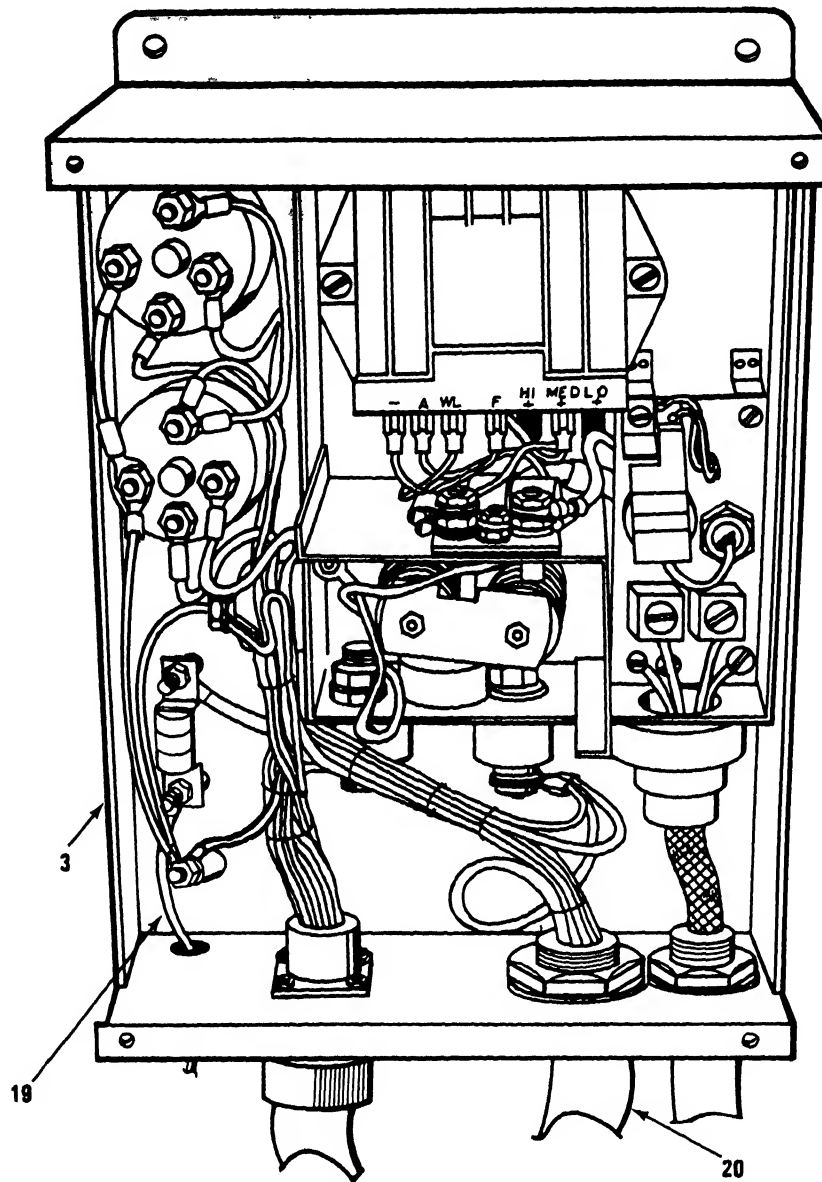
CONTROL BOX REPLACEMENT INSTRUCTIONS
(Continued)



CONTROL BOX REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		e Loosen terminal screws (10) and remove alternator wires (11) from terminals.	a Use flat tip and/or 13 mm wrench b Tag wires and make a location diagram for correct reconnection of wires on replacement control box (3)
		f Unscrew collar (12)	Use channel lock pliers
		g Unscrew nut (13)	Use 1-5/8 in wrench.
		h Separate shielding retainer (14) freeing shielding	Use screwdriver
		i Pull shielded cable (15) out of control box (3)	Keep nut (13) for reinstallation
		j Unscrew collar (16) and disconnect plug (17)	
		k Loosen nut (18) and remove battery wire (19)	Use 10 mm open end wrench

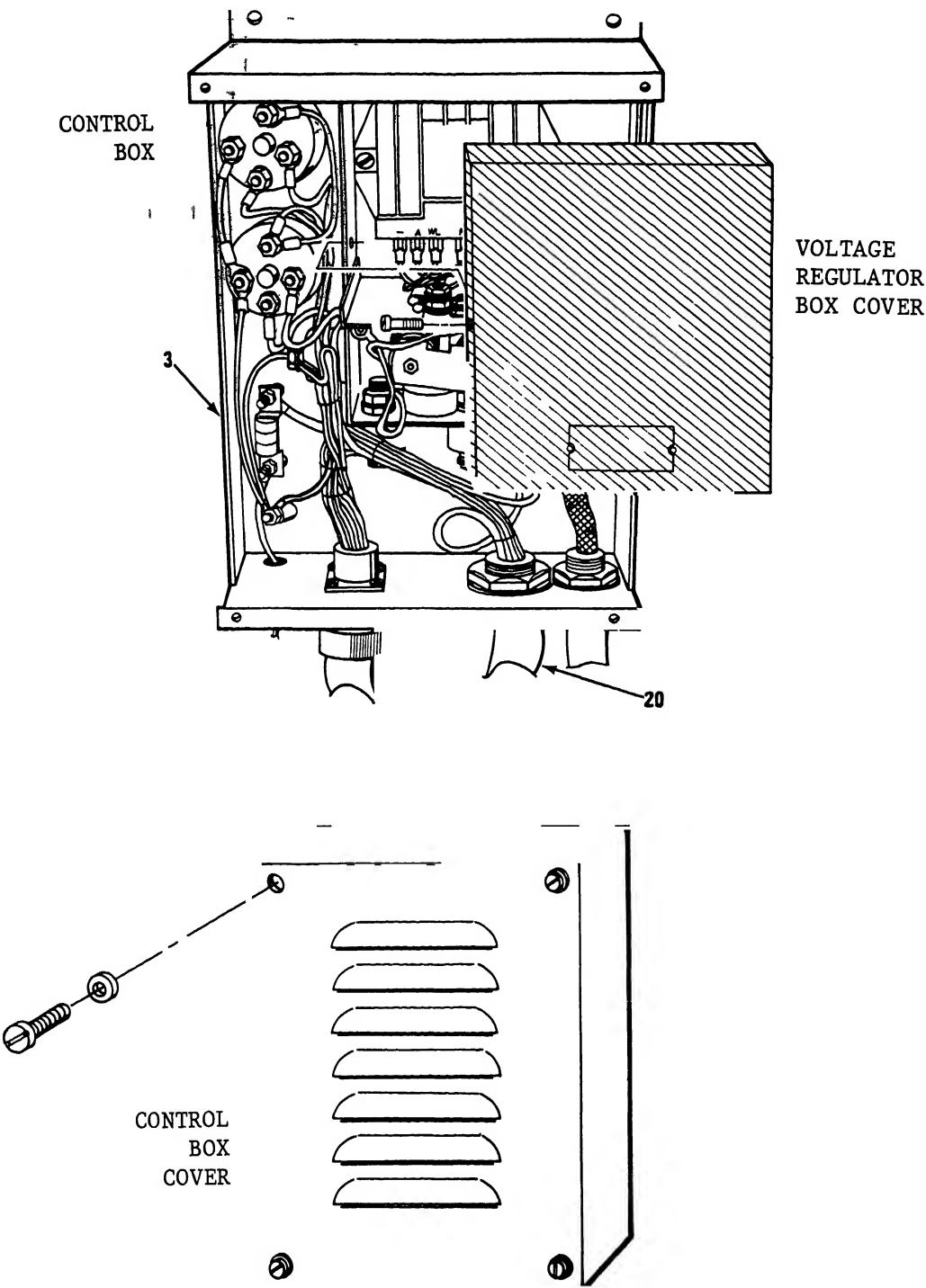
CONTROL BOX REPLACEMENT INSTRUCTIONS
(Continued)



CONTROL BOX REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		<p>1. Pull battery wire (19) out of control box (3).</p> <p>m. Remove control box (3) with its connected engine wiring harness (20) from battery compartment to suitable work area</p>	
2. Work area		<p>Disconnect engine wiring harness leads internal to the control box and remove engine wiring harness (20)</p>	<p>See page 'Engine Wiring Harness Replacement Instructions' for procedures to remove engine wiring harness</p>

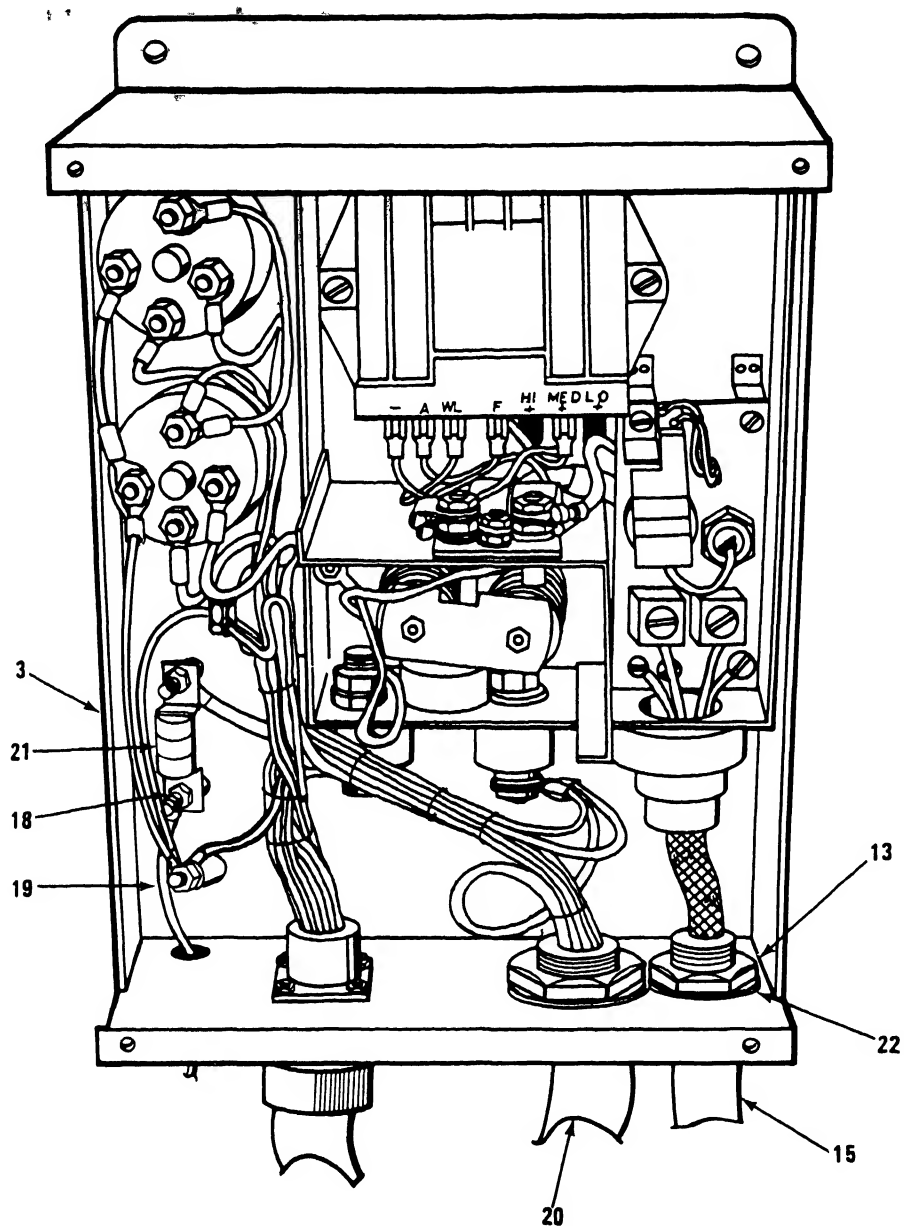
CONTROL BOX REPLACEMENT INSTRUCTIONS
(Continued)



CONTROL BOX REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
NOTE			
Before exchanging or discarding used control box check replacement control box for interconnector wires between components. Transfer needed cables from used control box to replacement box.			
<u>INSTALLATION</u>			
3	Work area	Control box (3)	<p>a Remove four screws (5), four washers (6) and control box cover (7) Use screwdriver.</p> <p>b Remove two screws (8) and voltage regulator box cover (9) Use screwdriver.</p> <p>c Inspect new control box (3) for interconnect wires between components</p> <p>d Transfer any needed interconnect wires from used control box to new control box Replacement control box may not have interconnect wires installed by supplier</p> <p>e Install engine wiring harness (20) in control box (3). See page Engine Wiring Harness Replacement Instructions for procedures.</p>

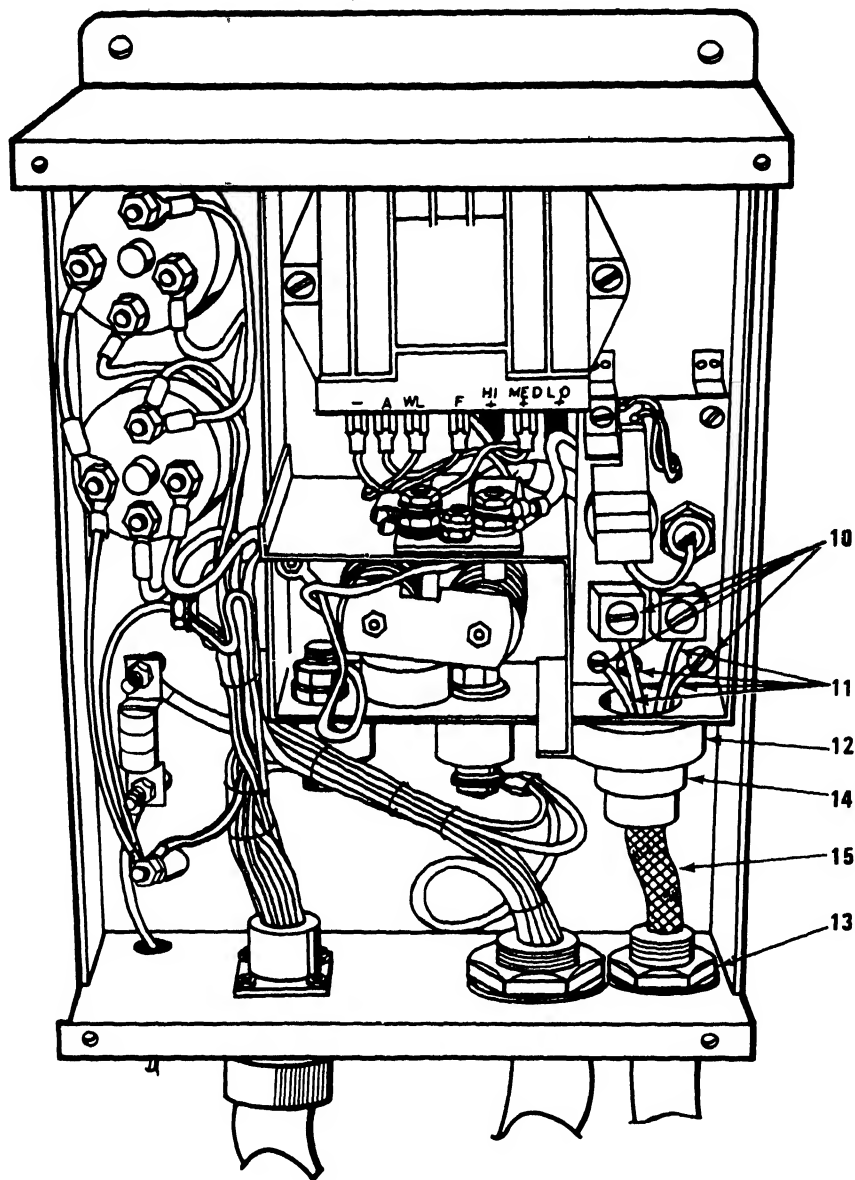
CONTROL BOX REPLACEMENT INSTRUCTIONS
(Continued)



CONTROL BOX REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
4 Battery compartment	Control box	<p>a. Place control box (3) with install engine wiring harness (20) on battery covers</p> <p>b. Feed engine wiring harness (20) into engine compartment</p> <p>c. Feed battery wire (19) into control box (3)</p> <p>d. Secure battery wire (19) to fast fuse (21) using nut (18)</p> <p>e. Feed shielded alternator cable (15) into control box (3)</p> <p>f. Place nut (13) over alternator cable (13) and screw onto fitting (22) securing cable to control box</p>	Use 10 mm open end wrench

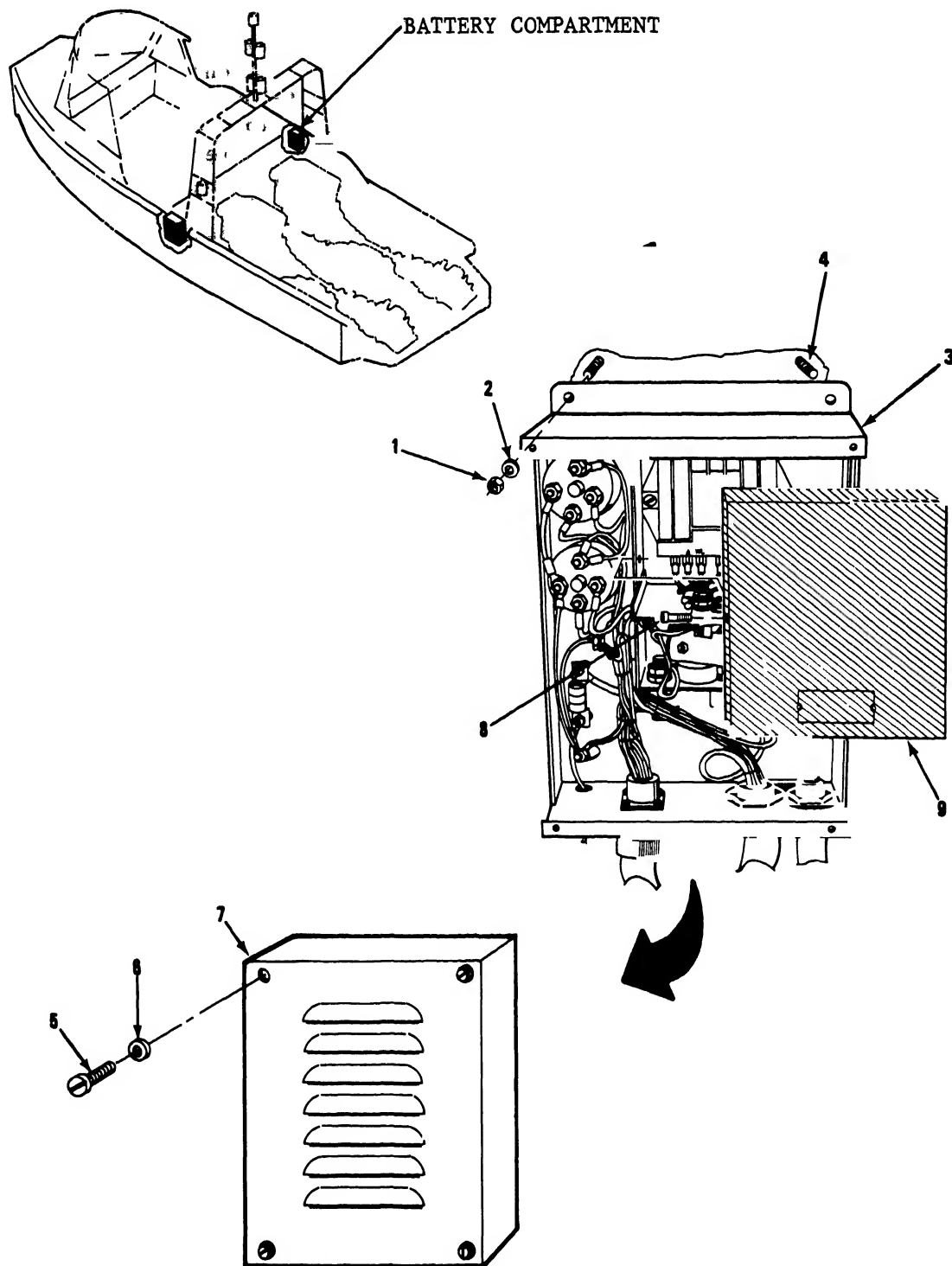
CONTROL BOX REPLACEMENT INSTRUCTIONS
(Continued)



CONTROL BOX REPLACEMENT INSTRUCTIONS (Continued)

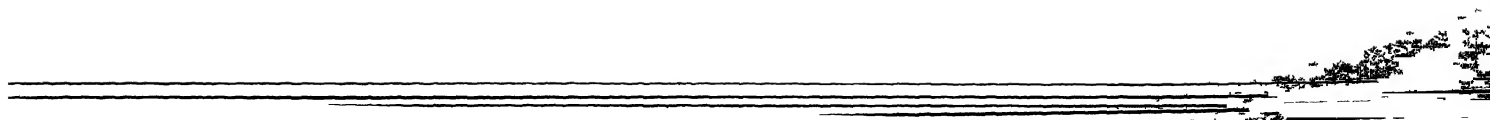
LOCATION	ITEM	ACTION	REMARKS
		g Slide collar (12) over end of alternator cable (15) and install wire shielding retainer (14) to end of cable.	
		h. Feed wires (11) into regulator box Install collar (12) securing cable (15) to the regulator box	
		i Connect wire (11) to terminals and tighten terminal screws (10) to secure	Use flat tip screwdriver

CONTROL BOX REPLACEMENT INSTRUCTIONS
(Continued)



CONTROL BOX REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		j Reinstall regulator box cover (9) and secure using two screws (8)	Use flat tip screwdriver
		k Reinstall control box cover (7) and secure using four screws (5) and four washers (6)	Use flat tip screwdriver
		l Install control box (3) on four studs (4) and secure to side of boat using four nuts (1) and four washers (2)	Use 10 mm socket with extensior
		m Connect plug (17) and secure by tightening collar (16)	
		n Reinstall engine wiring harness on engine.	See page "Engine Wiring Harness Replacement Instructions for installation procedures



ENGINE MOUNTS AND BRACKETS REPLACEMENT INSTRUCTIONS

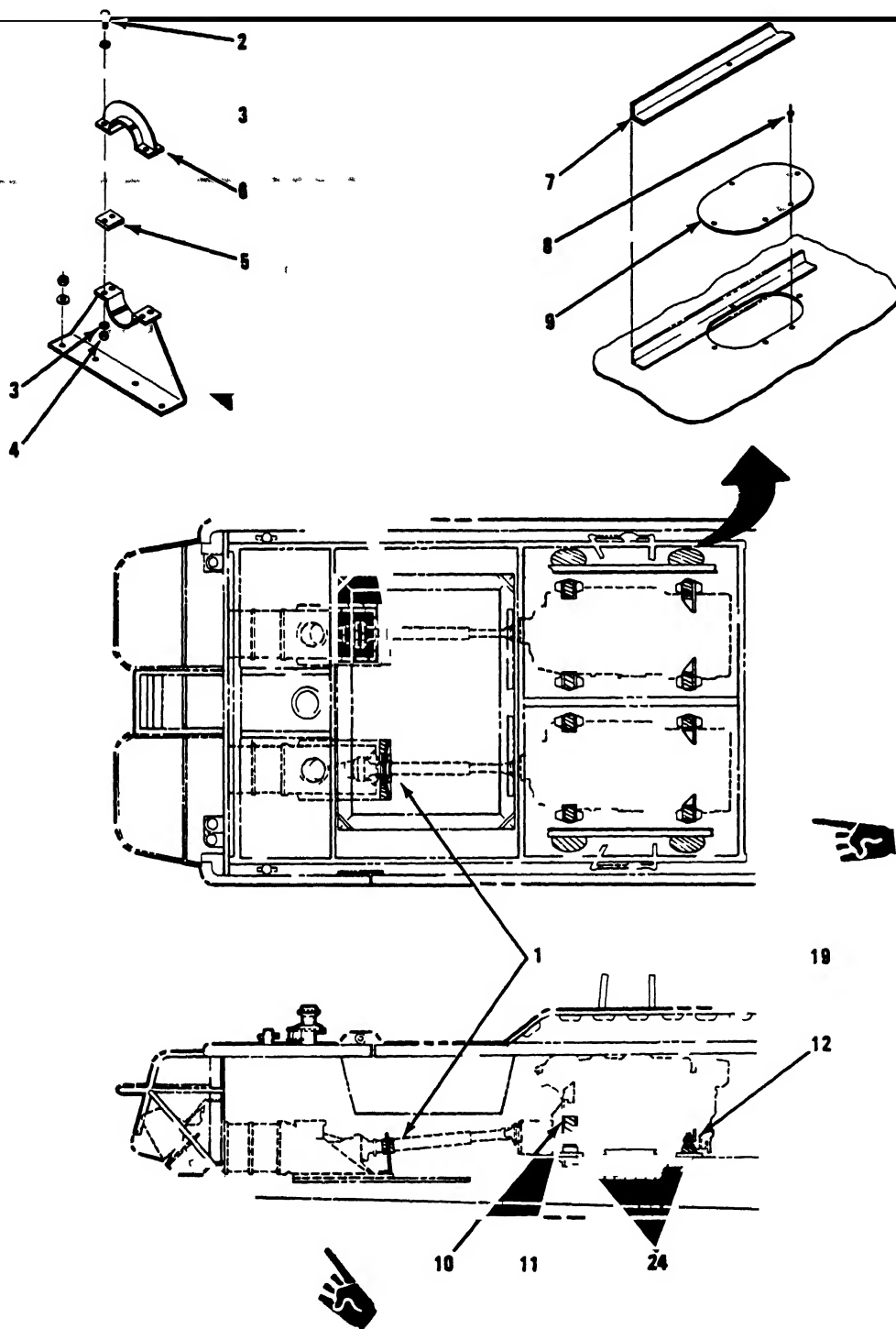
This task covers:

- a. Removal
- b. Installation

INITIAL SETUP

Tools:	Equipment Condition	Condition Description
Ratchet, 1/4 in drive	TM 5-1940-277-20	Aft cockpit removed.
6 in extension, 1/4 in drive	TM 5-1940-277-20	Engine hatches open and secured.
10 mm socket, 1/4 in drive	TM 5-1940-277-20	Batteries disconnected.
10 mm box wrench	TM 5-1940-277-20	Buoyancy flotation material removed (as required).
Portable electric drill		
1/4 in drill bit		
Ratchet, 1/2 in drive		
6 in extension, 1/2 in drive		
1-1/16 in socket, 1/2 in drive		
5/8 in socket, 1/2 in drive		
3/4 in socket, 1/2 in drive		
1/2 in socket, 1/2 in drive		
11/16 in open end wrench		
Torque wrench,		
0-175 ft-lb capacity, 1/2 in drive		
Blind rivet gun		
Lifting sling		
Hoist		
Materials/Parts		
Lockwashers, 7/16 in		
Flexible engine mount		
Aluminum rivets, 1/4 in		

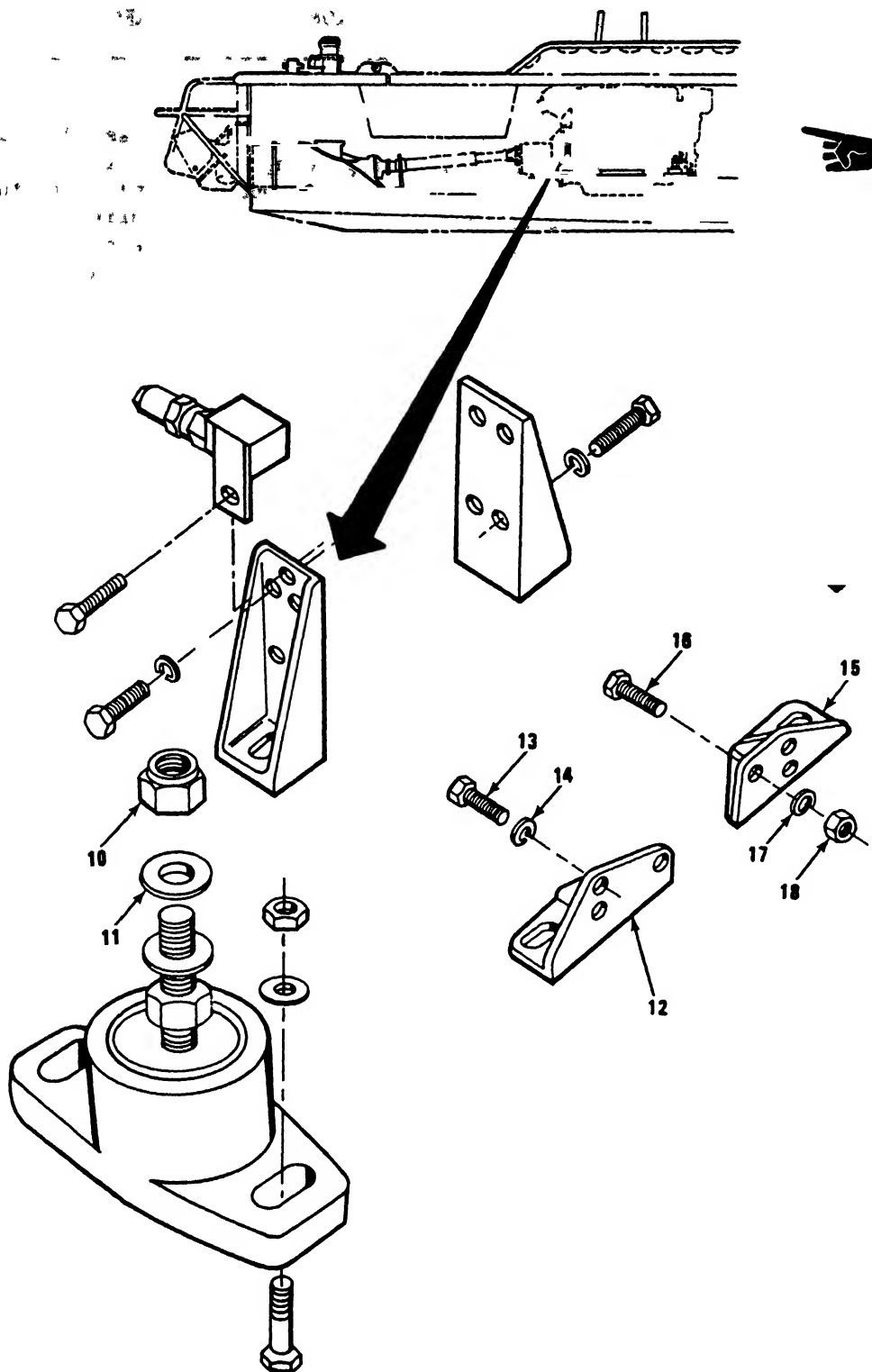
ENGINE MOUNTS AND BRACKETS REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE MOUNTS AND BRACKETS REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
1 Drive shaft (1)	4 bolts (2), 8 washers (3), 4 nuts (4), 2 spacers (5) and drive shaft guard top plate (6)	Remove if replacing engine mount.	Use 10 mm socket, 6 in extension with 1/4 in drive, ratchet, and 10 mm box wrench.
2. Engine compartment	9 rivets (8) securing access cover (9) and flotation blocking bracket (7)	a. Drill out rivets. b. Remove cover and bracket.	Use portable electric drill with 1/4 in bit (only required for replacement of outboard mount).
3. Engine assembly	a 4 nuts (10) and 4 washers (11)	a Remove for engine mount replacement. b Loosen for bracket replacement	Use 1-1/16 in socket, 6 in extension, 1/2 in drive ratchet

ENGINE MOUNTS AND BRACKETS REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE MOUNTS AND BRACKETS REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

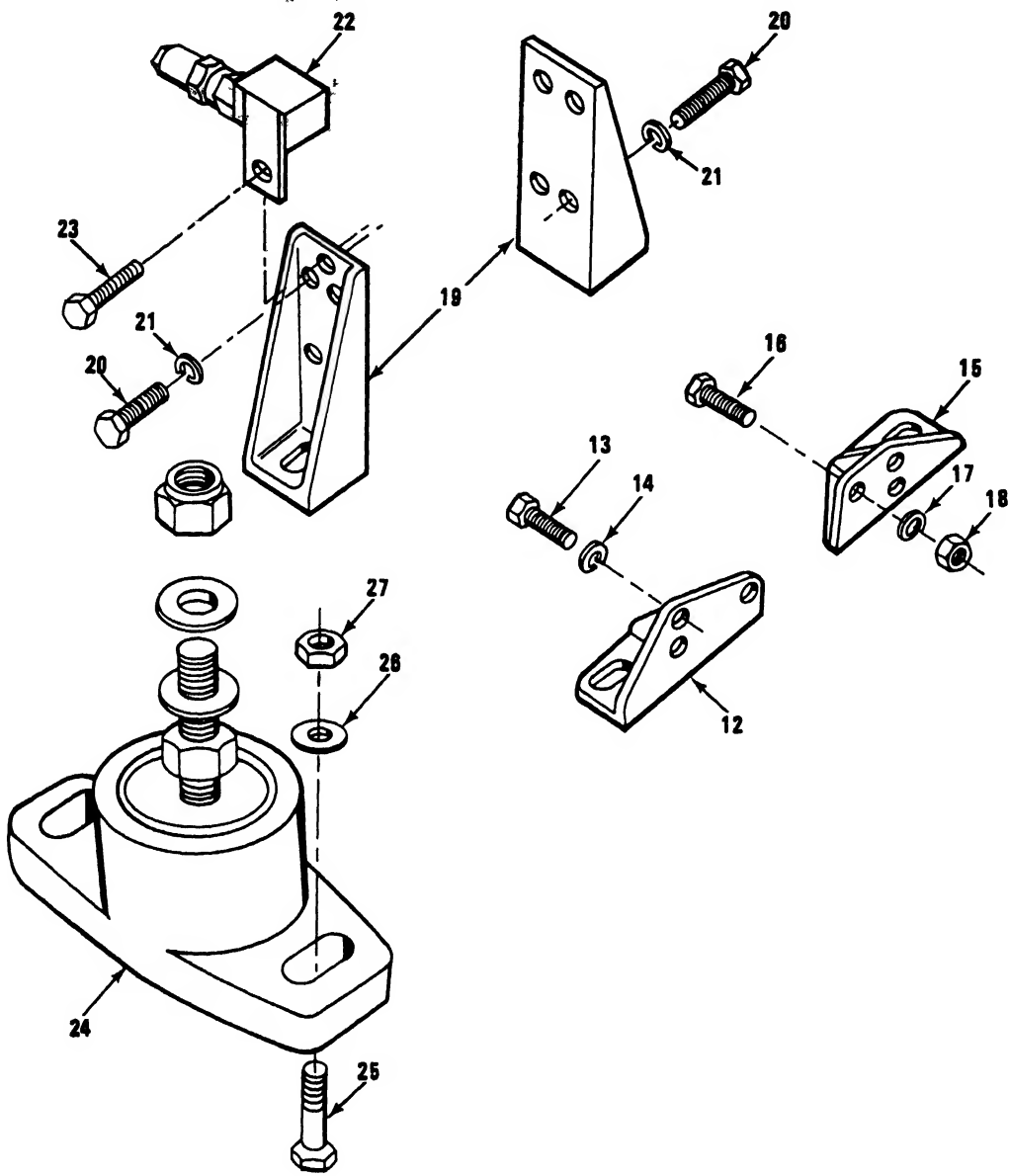
	b. Engine assembly	a Attach lifting sling to lifting eyes b. Raise only as high as necessary • For bracket, replacement, take weight off bracket. • For mount replacement, clear mounting bolt (approx 1-1/2 in)	
--	--------------------	--	--

NOTE

Remove and replace only defective bracket or mount

c	Starboard front bracket (12), 3 cap screws (13), lockwashers (14)	a Remove b Discard lockwashers	Use 5/8 in socket, 1/2 in drive ratchet
d	Port front bracket (15), 3 bolts (16), 3 lockwashers (17), 3 nuts (18)	a Remove b Discard lockwashers	Use 5/8 in socket, 1/2 in drive ratchet and 11/16 in box wrench

ENGINE MOUNTS AND BRACKETS REPLACEMENT INSTRUCTIONS
(Continued)



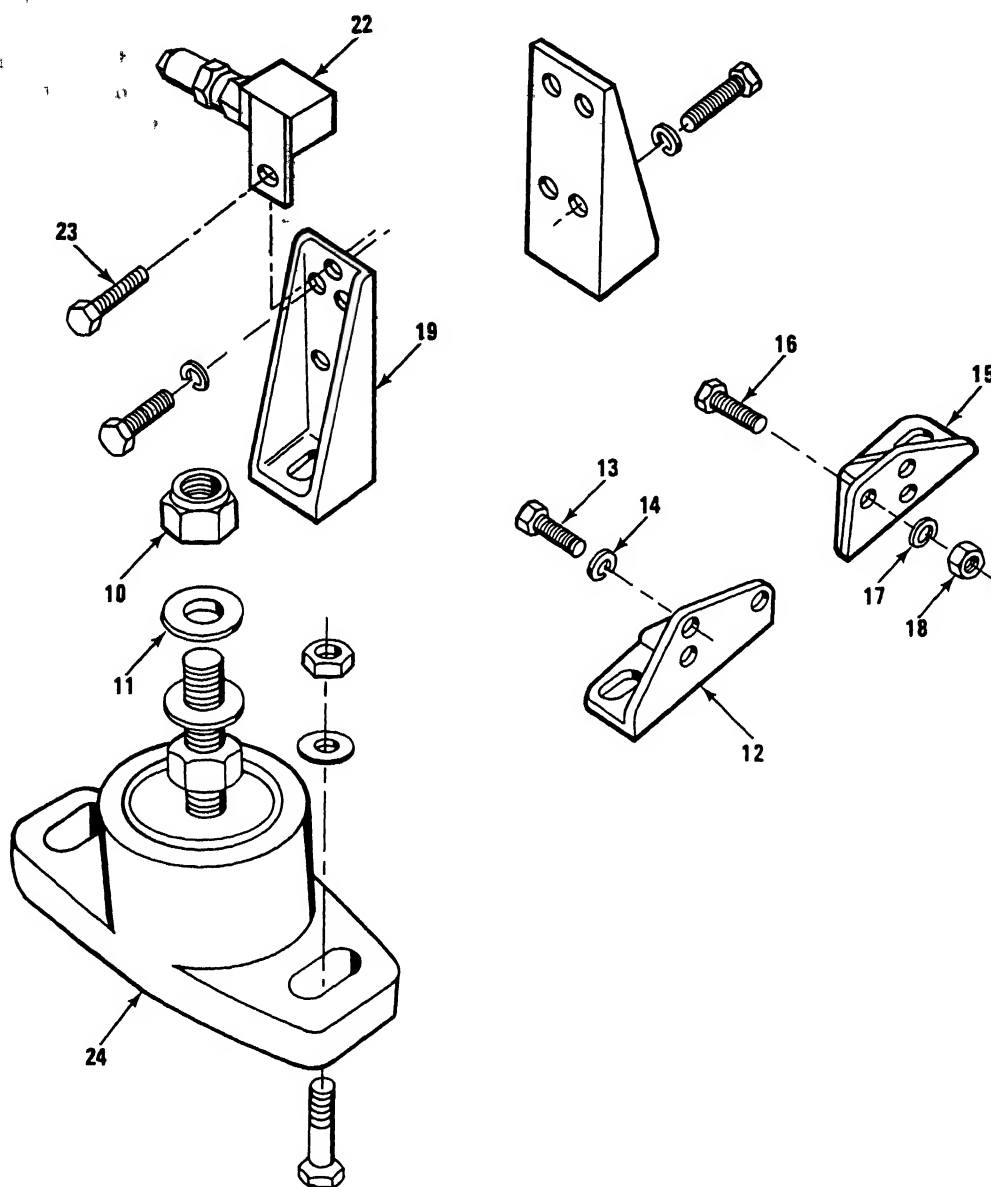
ENGINE MOUNTS AND BRACKETS REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	e. Rear bracket (19), 7 bolts (20) and 4 lockwashers (21)	a. Remove.	Use 5/8 in socket, 1/2 in drive ratchet and 6 in extension.
		b Discard lockwashers.	
	f. Fuel return line bracket (22) at starboard rear bracket (19) and setscrew (23)	Remove.	Use 1/2 in socket with 1/2 in drive ratchet
	g. Engine mount (24), 2 bolts (25), 2 washers (26) and 2 nuts (27)	Remove.	Use 3/4 in socket, 1/2 in drive ratchet and 3/4 in box wrench

INSTALLATION

4	a Engine mount (24), 2 bolts (25), 2 washers (26) and 2 nuts (27)	Install securing mount to boat frame	Use 3/4 in socket, 1/2 in drive ratchet and 3/4 in box wrench
	b Engine assembly	Clean face where new bracket is to be fitted	
	c Rear bracket (19), 4 bolts (20) and 4 lockwashers (21)	Install securing bracket to cylinder block	Use 5/8 in socket, 1/2 in drive ratchet and 6 in extension

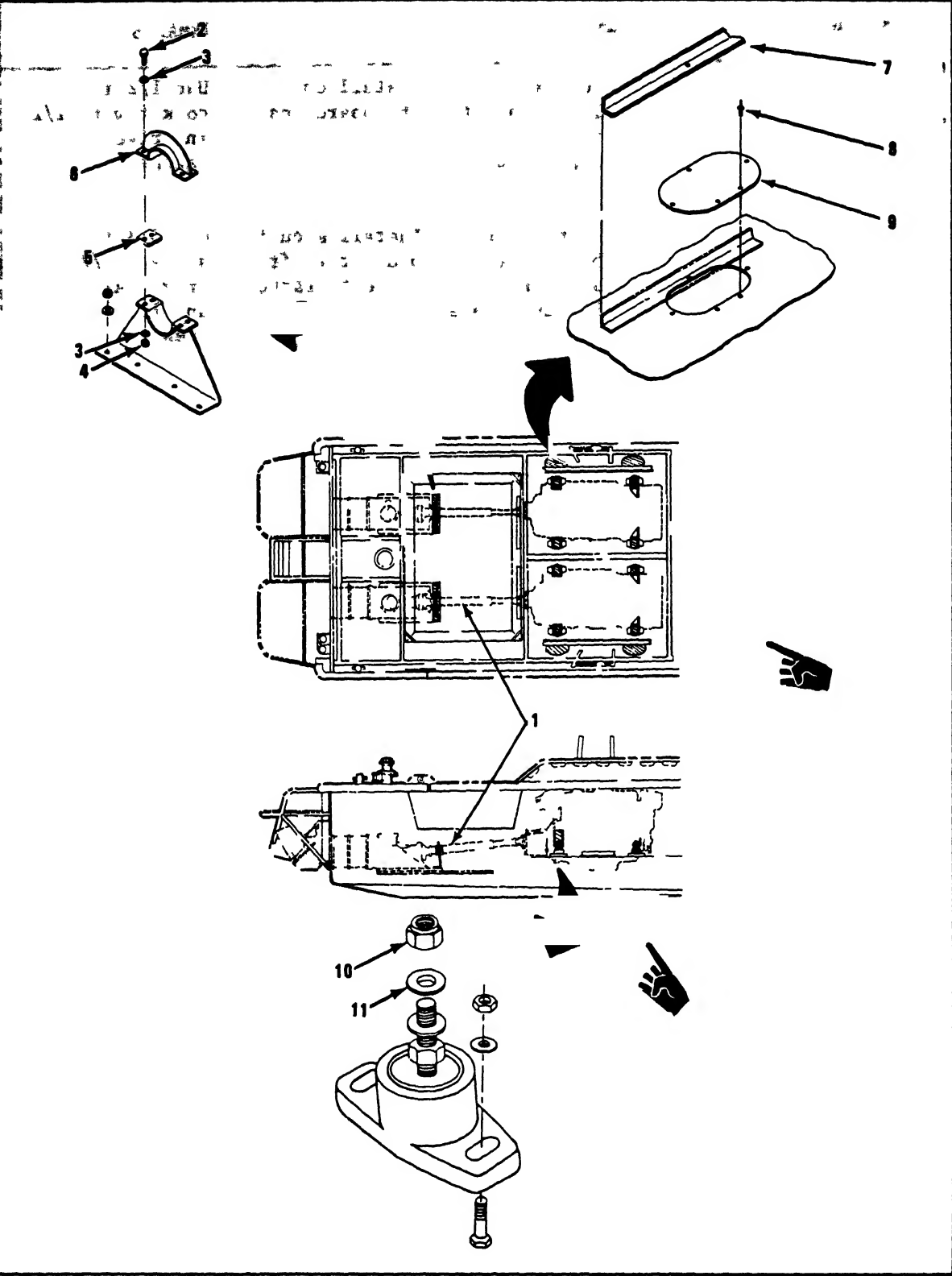
ENGINE MOUNTS AND BRACKETS REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE MOUNTS AND BRACKETS REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	d. Fuel return line bracket (22) and cap screw (23)	Install on starboard rear bracket (19).	Use 1/2 in socket with 1/2 in drive ratchet.
	e. Port front bracket (15), 3 bolts (16), 3 lockwashers (17), and 3 nuts (18)	Install securing bracket to front support brackets.	Use 5/8 in socket, 1/2 in drive ratchet and 11/16 in open end wrench.
	f. Starboard front bracket (12), 4 bolts (13) and 4 lockwashers (14)	Install securing bracket to cylinder block.	Use 5/8 in socket and 1/2 in drive ratchet.
	g. Engine assembly	Lower onto mounts (24).	If necessary, loosen bracket and reposition slightly for correct seating on mount. Re-tighten bracket.
	h. 4 nuts (10) and 4 washers (11)	Install, securing engine to mount Torque 30 - 35 ft-lb (4 15 to 4 84 kgfm)	Use 3/4 in socket and torque wrench, 0 - 175 ft-lb capacity
	i. Engine assembly	Remove lifting sling.	

ENGINE MOUNTS AND BRACKETS REPLACEMENT INSTRUCTIONS
(Continued)



MOUNTS AND BRACKETS REPLACEMENT INSTRUCTIONS
 nued)

ON	ITEM	ACTION	REMARKS
Engine compartment	Access cover (9) and flotation blocking bracket (7)	Rivet in place	Use 1/4 in blind aluminum rivets and rivet gun
Drive shaft (1)	Drive shaft guard top plate (6), 4 bolts (2), 8 washers (3), 4 nuts (4) and 2 spacers (5)	Install	Use 10 mm socket, ratchet, and 10 mm box wrench

W

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

11/11/11

ENGINE ASSEMBLY TEST INSTRUCTIONS

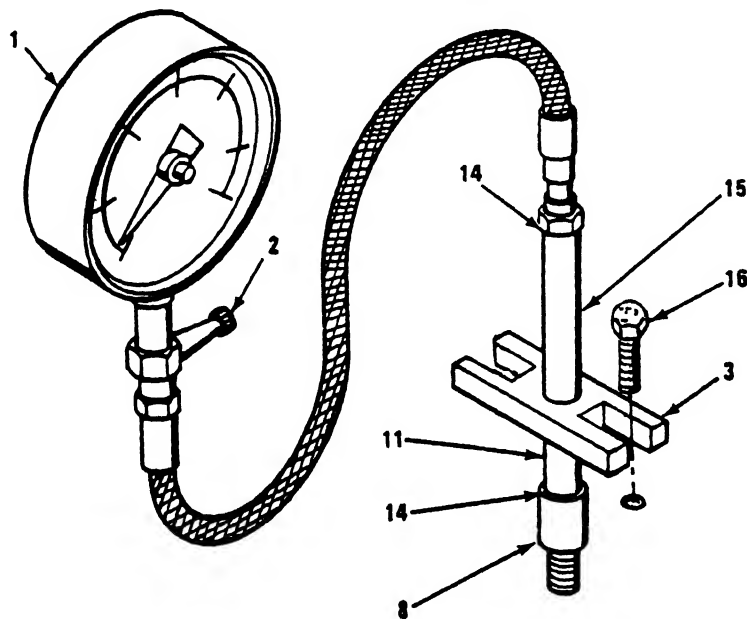
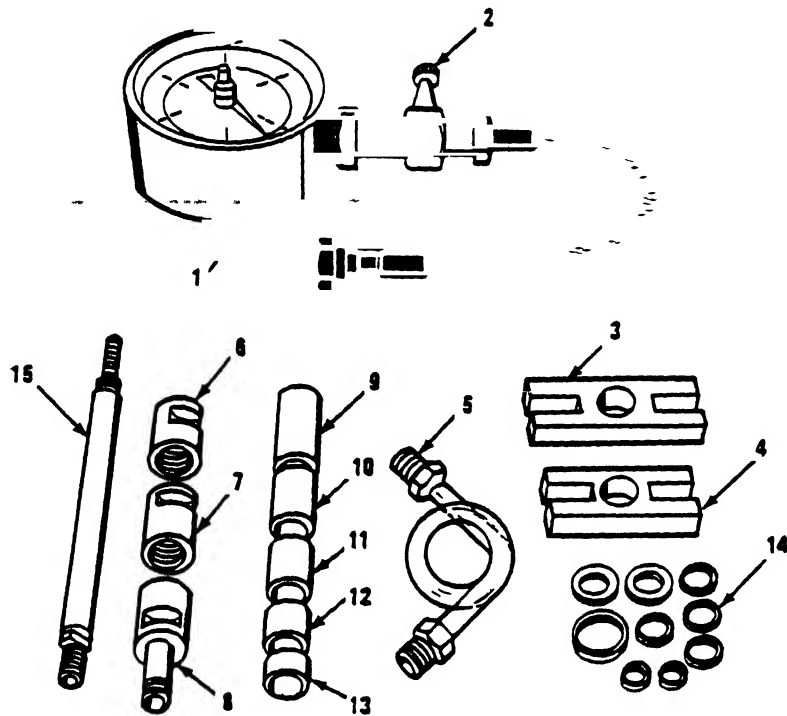
his task covers

. Engine compression test

INITIAL SETUP

Tools	Equipment Condition	Condition Description
1/2 in socket	TM 5-1940-277-20	Injector removed
Extension		
Torque wrench		

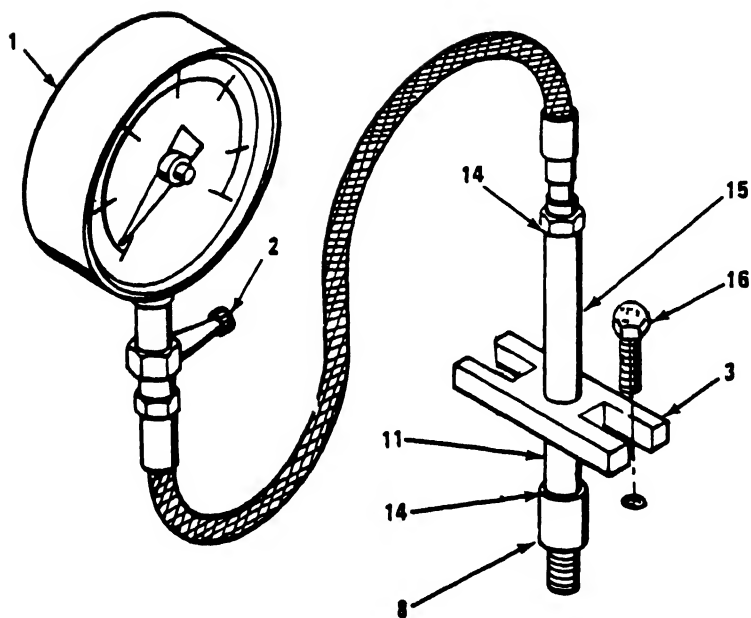
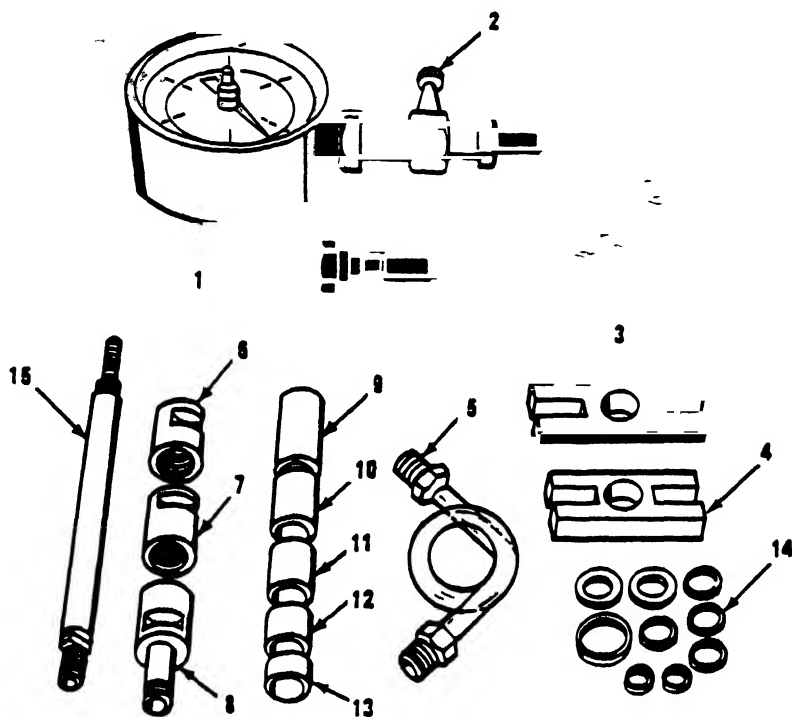
ENGINE ASSEMBLY TEST INSTRUCTIONS
(Continued)



ASSEMBLY TEST INSTRUCTIONS (continued)

ON	ITEM	ACTION	REMARKS
	<p>inder head</p> <p>Compression gage (1)</p>	<p>a Install injector seal washer (14)</p> <p>b Position gage in injector mounting hole</p>	
NOTE			
<p>mpression gage crosshead must be positioned so that gage does not tom out when fit in mounting hole.</p>			
	<p>mpression gage)</p> <p>Injector mounting bolt (16)</p>	<p>a. Install two bolts through gage crosshead (3) Tighten bolts finger tight</p> <p>b Screw gage into crosshead until gage stem bottoms against injector seat</p> <p>c Torque injector mounting bolts (16) to 14 to 16 ft-lbs (19 0 to 31 7 Nm)</p> <p>d Turn gage pressure release screw (2) clockwise until closed</p>	<p>Use fingers</p>

ENGINE ASSEMBLY TEST INSTRUCTIONS (Continued)



ENGINE ASSEMBLY TEST INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
3. Control console	Engine stop handle	Pull out.	
4. Engine compartment	Engine	Using starter turn engine over 5 - 6 revolutions. Read compression on gage (1). A reading of over 300 psi is satisfactory.	
5. Compression gage (1)	Pressure release screw (5)	Turn counter-clockwise to release pressure until gage reads zero.	Use fingers.

NOTE

Repeat process for each cylinder. A pressure differential between cylinders of greater than 125 psi is unsatisfactory. Report to supervisor

11

12

13

14

ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS

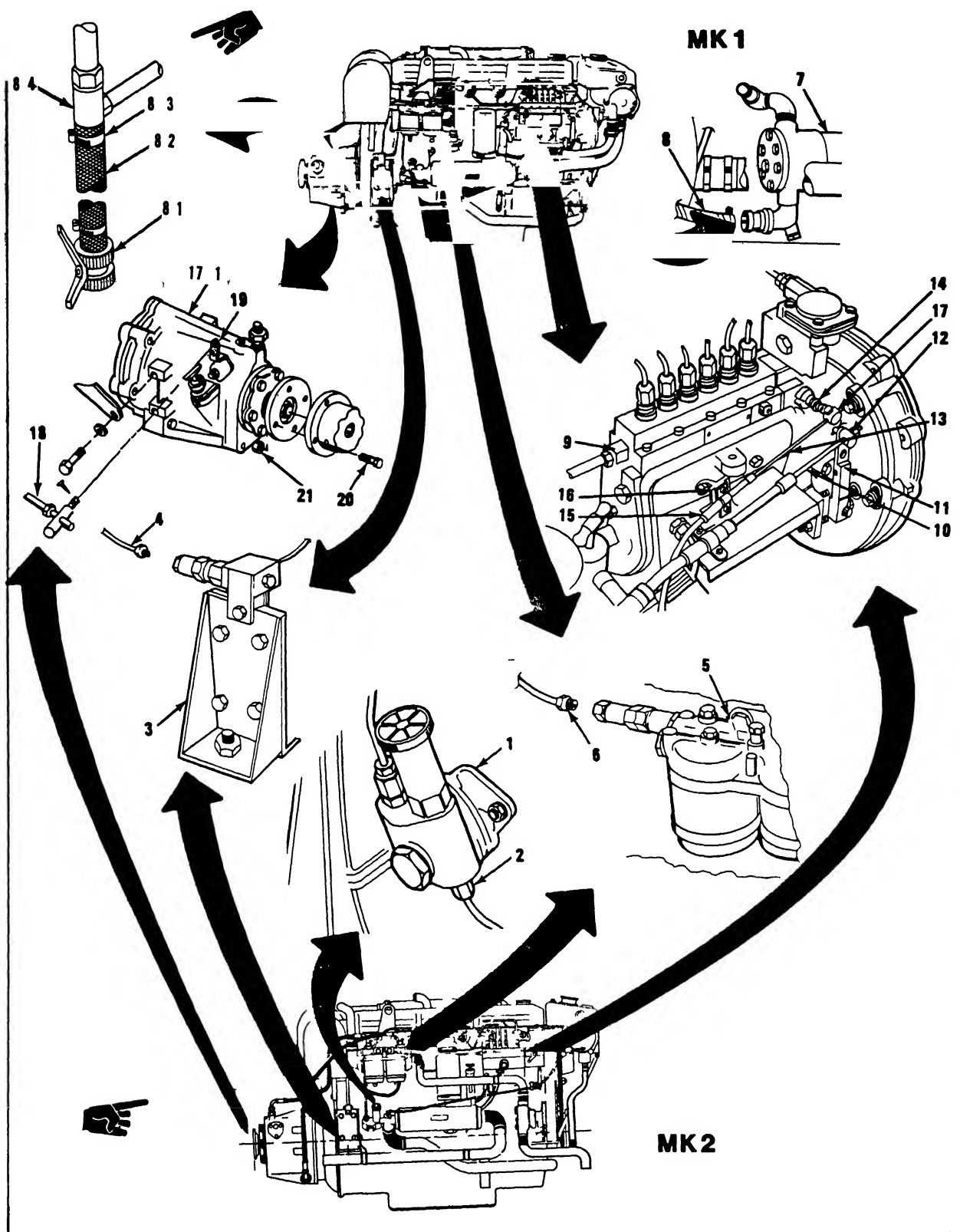
This task covers

- a. Removal
- b. Transfer of components to replacement engine
- c. Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Ratchet with 1/2 in drive	TM 5-2090-202-12&P	Boat out of water on grounded cradle
15/16 in socket		Engine compartment hatches open and secured
1 in socket	TM 5-1940-277-20	
6 in extension		
Ratchet with 3/8 in drive		
1/2 in socket	TM 5-1940-277-20	Master switch off
8 mm open end wrench	TM 5-1940-277-20	Buoyancy flotation material removed
11/16 in open end wrench		
5/8 in open end box wrench		
7/16 in box wrench		
1/2 in box wrench		
Flat tip screwdriver, 6 in		
Lifting sling		
Lifting device		
Drain pan		
Wooden blocking		
Torque wrench (0-175 ft-lb), 1/2 in drive		
Pliers		
11/16 in box wrench		
1-1/8 in socket		
1/2 in open end wrench		
11/16 in open end box wrench		
1 in open end box wrench		
Materials/Parts		
Replacement engine		
Engine oil		
Anti-freeze		
Cotter pin		
Gasket		
Personnel Required	Two	

ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

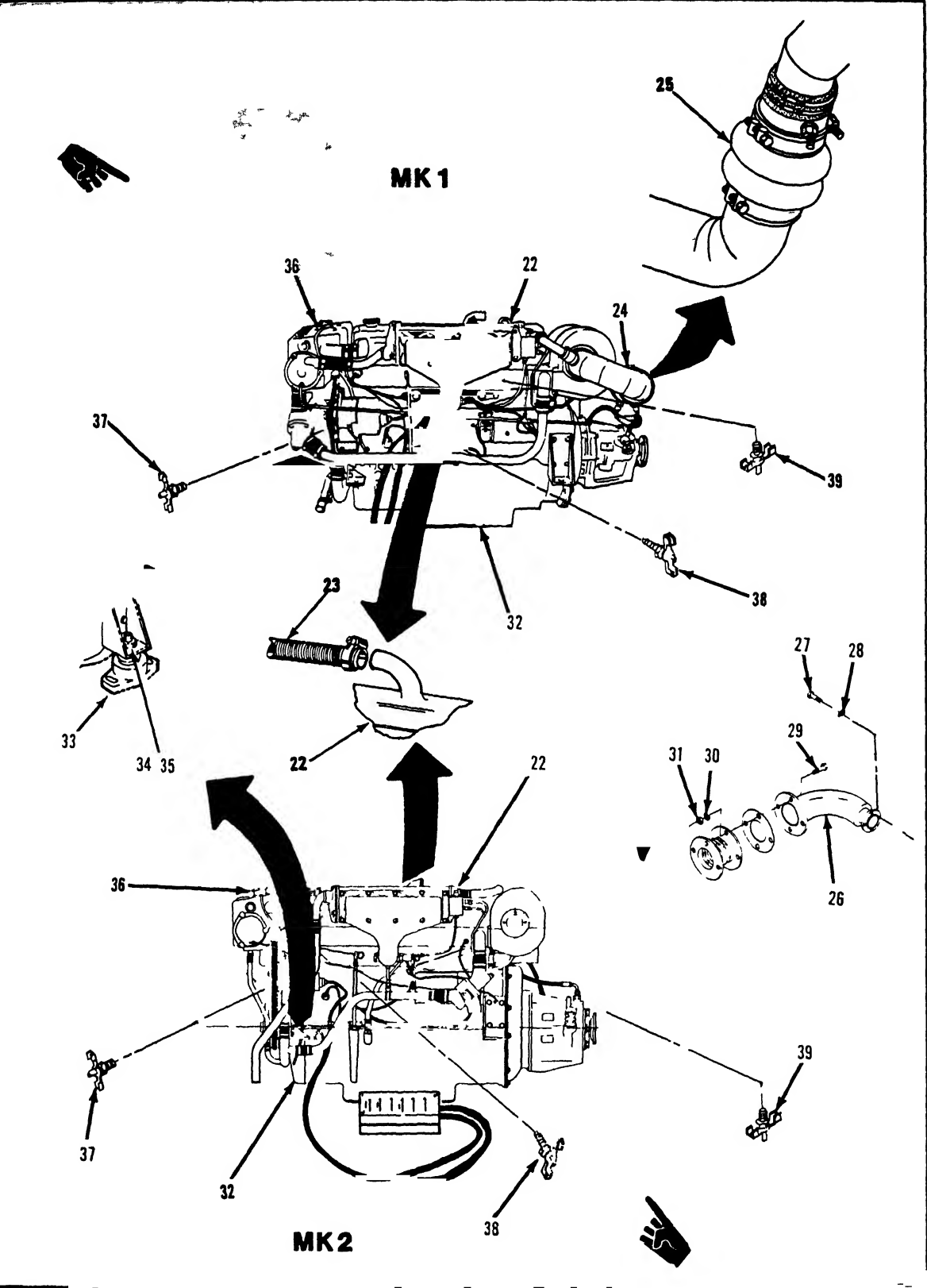


ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
1. Fuel lift pump (1)	Fuel feed line (2)	Disconnect.	Use 13/16 in open end box wrench.
2. Starboard rear engine mounting bracket (3)	Fuel return line (4)	Disconnect.	Use 5/8 in open end box wrench.
3. Fuel filters (5)	Fuel return line (6)	Disconnect.	Use 5/8 in open end box wrench.
4. Raw water pump (7) (MK1)	Intake hose (8)	Loosen clamp and disconnect.	Use screwdriver.
5. Raw water drain (8 1) (MK1)	Drain hose (8 2)	Loosen clamp (8.3) and disconnect from pipe (8.4)	Use screwdriver.
6. Injection pump (9)	a Cable (10) to speed selector lever (11)	Remove cotter pin (12) and withdraw bracket	Use pliers and screwdriver.
	b Cable (13) to engine stop lever (14), bracket (15) and 2 screws (16)	Loosen setscrew (17), remove bracket (15) and withdraw cable (13)	Use 8 mm open end wrench and screwdriver
7. Transmission (17 1)	a Cable (18) to selection lever (19)	Remove cotter pin and withdraw bracket	Use pliers and screwdriver
	b 4 bolts (20) and 4 nuts (21) securing transmission to drive shaft	Remove	Use 11/16 in open end wrench and 11/16 in box wrench

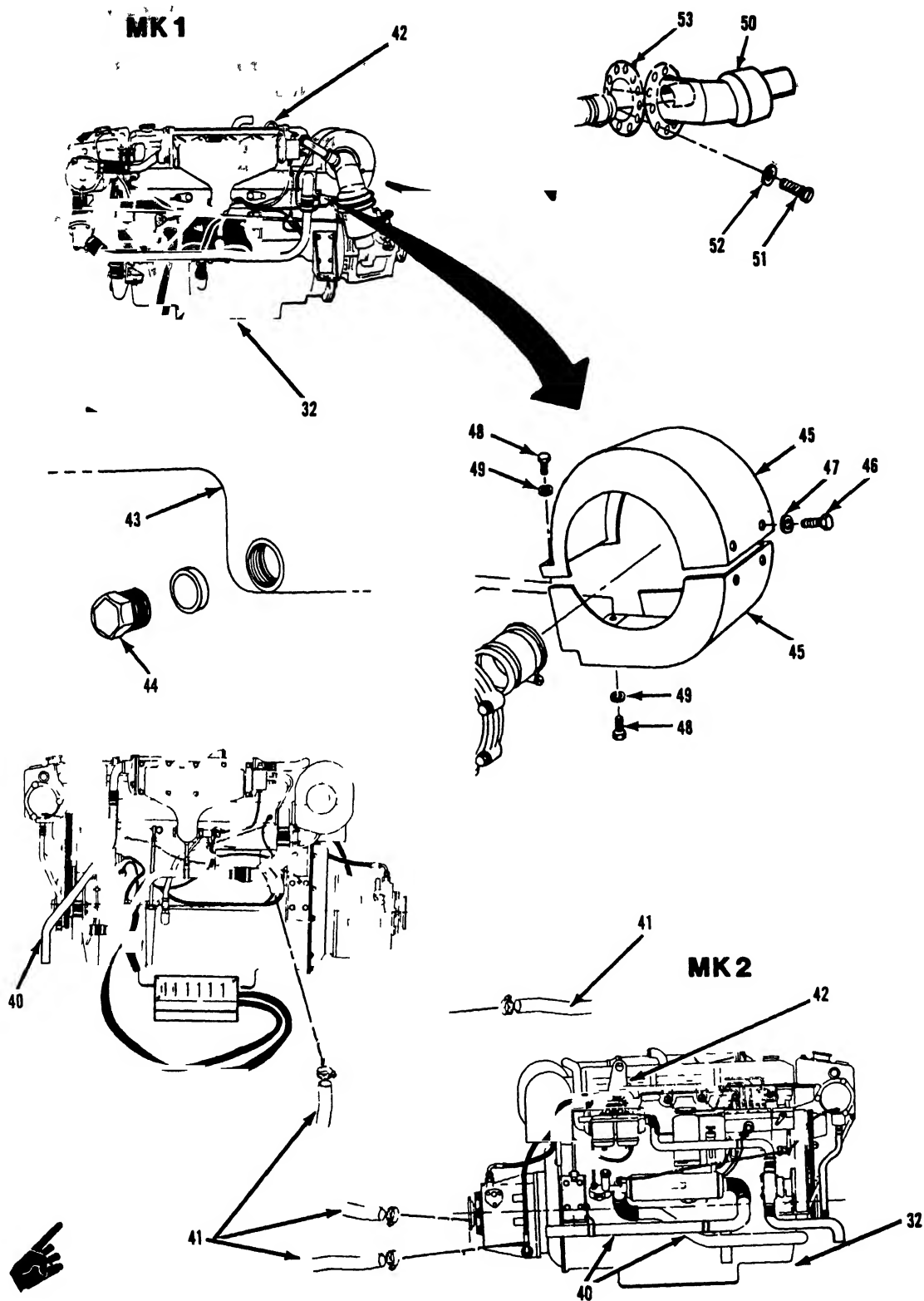
ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
8. Rocker arm cover (22)	Breather hose (23)	Loosen clamp and disconnect	Use screwdriver.
9. Exhaust pipe (24) (MK1)	Exhaust bellows (25)	Loosen clamp and disconnect	Use 1/2 in box wrench.
10. Exhaust return pipe (26) (MK2)	a. 4 bolts (27) and washers (28) securing exhaust return pipe to turbo-charger	Remove	Use 1/2 in socket and 3/8 in ratchet
	b. 4 bolts (29), washers (30), and nuts (31) securing exhaust return pipe to flexible connection	Remove and withdraw exhaust return pipe	Use 1 in socket, 1/2 in ratchet, and 12 in open end box wrench
11. Engine assembly (32)	Wiring looms to engine and screened alternator loom	Disconnect from all points on engine assembly	See page 2-93 for instructions and figure
12. Engine mounts (33)	4 nuts (34) and 4 washers (35)	Remove	Use 1-1/8 in socket, 6 in extension, 1/2 in ratchet
13. Engine assembly (32)	a. Fresh water filler cap (36)	Remove	
	b. 3 petcocks (37, 38, and 39)	a. Open, drain cooling system into suitable container b. Close when system drained	
	c. Fresh water filler cap (36)	Reinstall	

ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

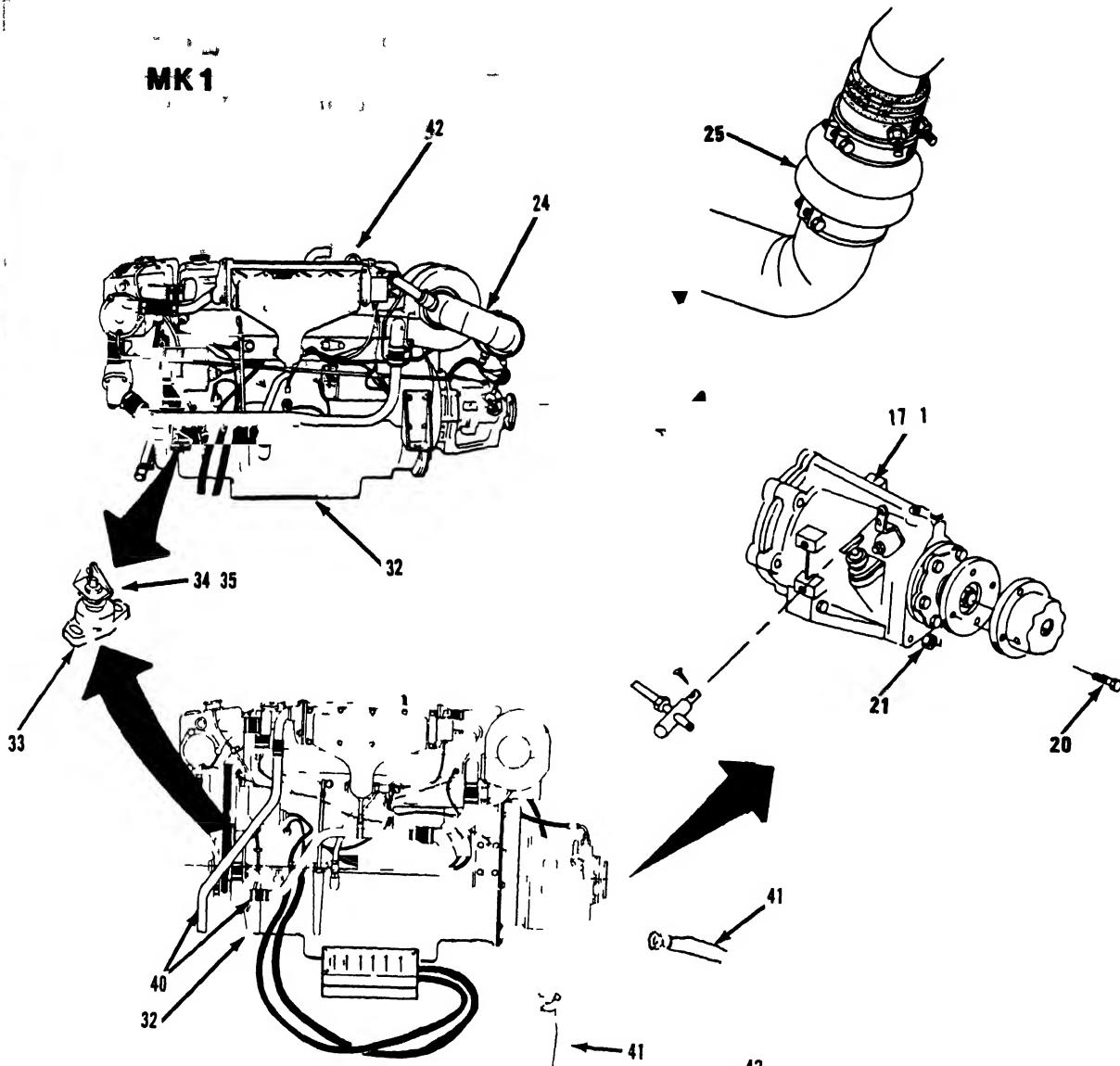


ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

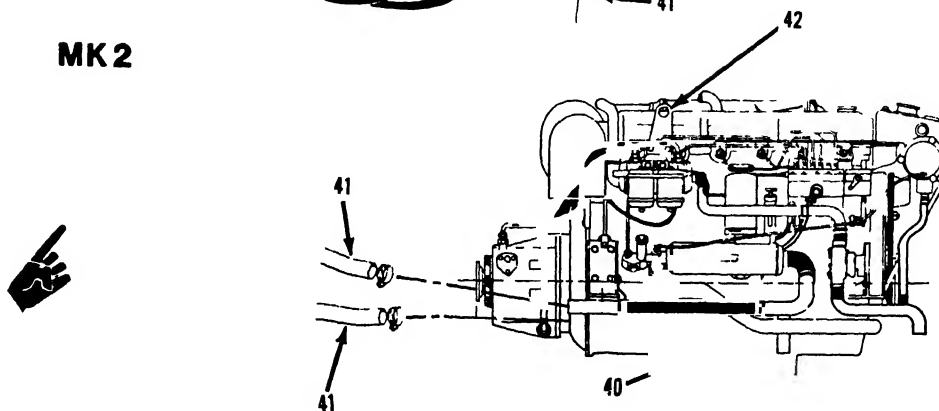
LOCATION	ITEM	ACTION	REMARKS
14. Coolant inlet and outlet pipes (40) (MK2)	Keel cooler hoses (41)	Loosen clamps and disconnect	Use screwdriver
15. Engine assembly (32)	Engine assembly (32)	a. Attach lifting sling to lifting eyes (42). b. Raise engine out of boat c. Mount engine on blocks	Use lifting device Use blocks
16. Oil sump (43)	Drain plug (44)	a. Remove plug, drain engine oil	Use drain pan Use 15/16 in socket and 1/2 in ratchet
<u>TRANSFER OF COMPONENTS TO REPLACEMENT ENGINE</u>			
17. Engine assembly (32)	a. Heat shield (45), bolt (46), washer (47), 2 bolts (48) and 2 washers (49) (MK1) b. Exhaust elbow (50), 4 bolts (51), 4 washers (52) and gasket (53) (with any attached exhaust pipe) (MK1) c. Heat shield (45), bolt (46), washer (47), 2 bolts (48) and 2 washers (49) (MK1)	Remove both used and replacement engine assemblies. Transfer to replacement engine. Discard gasket and replace with new gasket Reinstall on used and replacement engine assemblies	Use 1/2 in socket with ratchet Use 1/2 in socket with 3/8 in ratchet and 1/2 in open end wrench Use 1/2 in socket with ratchet

ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

MK1



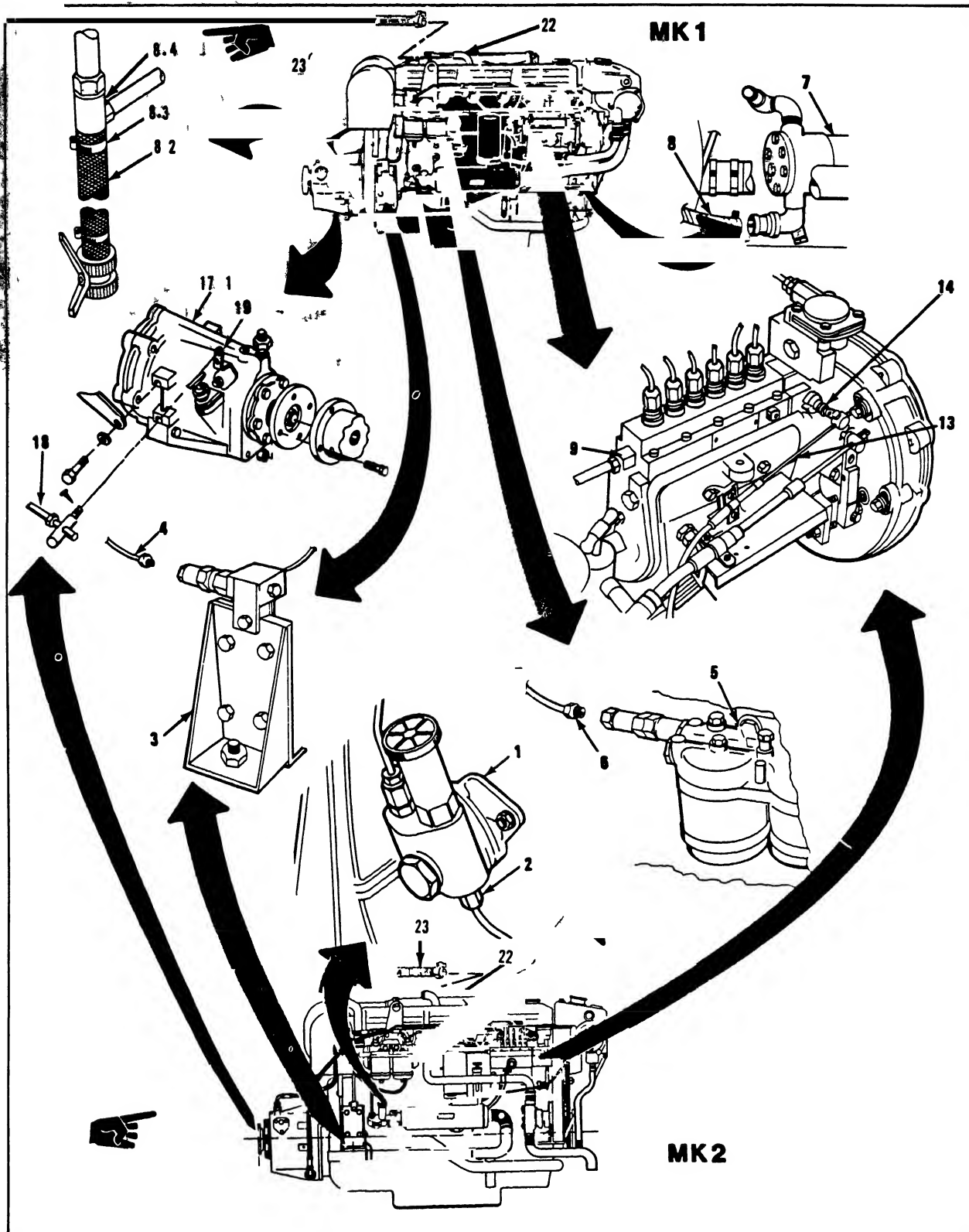
MK2



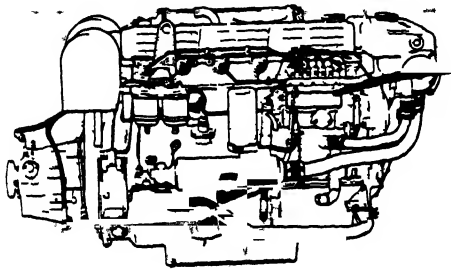
ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	d Transmission (17 1) MK1, and MK2	Transfer to replacement engine.	See page 2-327 for procedure.
18. Replacement engine assembly (32)	a. Engine assembly (32)	a. Attach sling to lifting eyes (42).	
		b. Lift engine into boat, position on mounts (33)	Use lifting device.
	b Keel cooler hoses (41) (MK2)	Connect inlet and outlet pipes (40) and tighten hose clamps	Use screwdriver
	c 4 bolts (20) and 4 nuts (21)	Install and tighten, securing transmission to drive shaft	Use 11/16 in open end wrench and 11/16 in box wrench
	d. 4 nuts (34) and 4 washers (35)	Torque to 30-35 ft-lb (4 15 to 4 84 kg m) securing engine to mounts	Use torque wrench (0-175 ft-lb)
	e Wiring loom to engine and screened alternator loom	Secure connectors to contact points	See page 2-87 for procedures
	f Exhaust bellows (25) (MK1)	Connect to exhaust pipe (24) and tighten hose clamp	Use 1/2 in box wrench

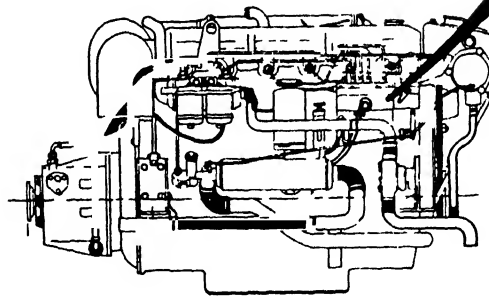
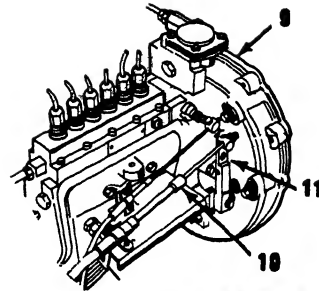
ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)



ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



MK1



MK2

ENGINE ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	o. Cable (10) to speed selector lever (11) on injector pump (9)	Install and adjust.	See TM 5-1940-277-20.
<p style="text-align: center;">NOTE</p> <p>Service engine in accordance with TM 5-1940-277-20 and LO 5-1940-277-12/LI 1940-12.</p>			

7. 夫、
人、
之、
性、
也、
善、
也、
惡、
也、
未、
可、
知、
也、
也、

1. 夫、
人、
之、
性、
也、
善、
也、
惡、
也、
未、
可、
知、
也、
也、

1

5

STARTER MOTOR REPAIR INSTRUCTIONS

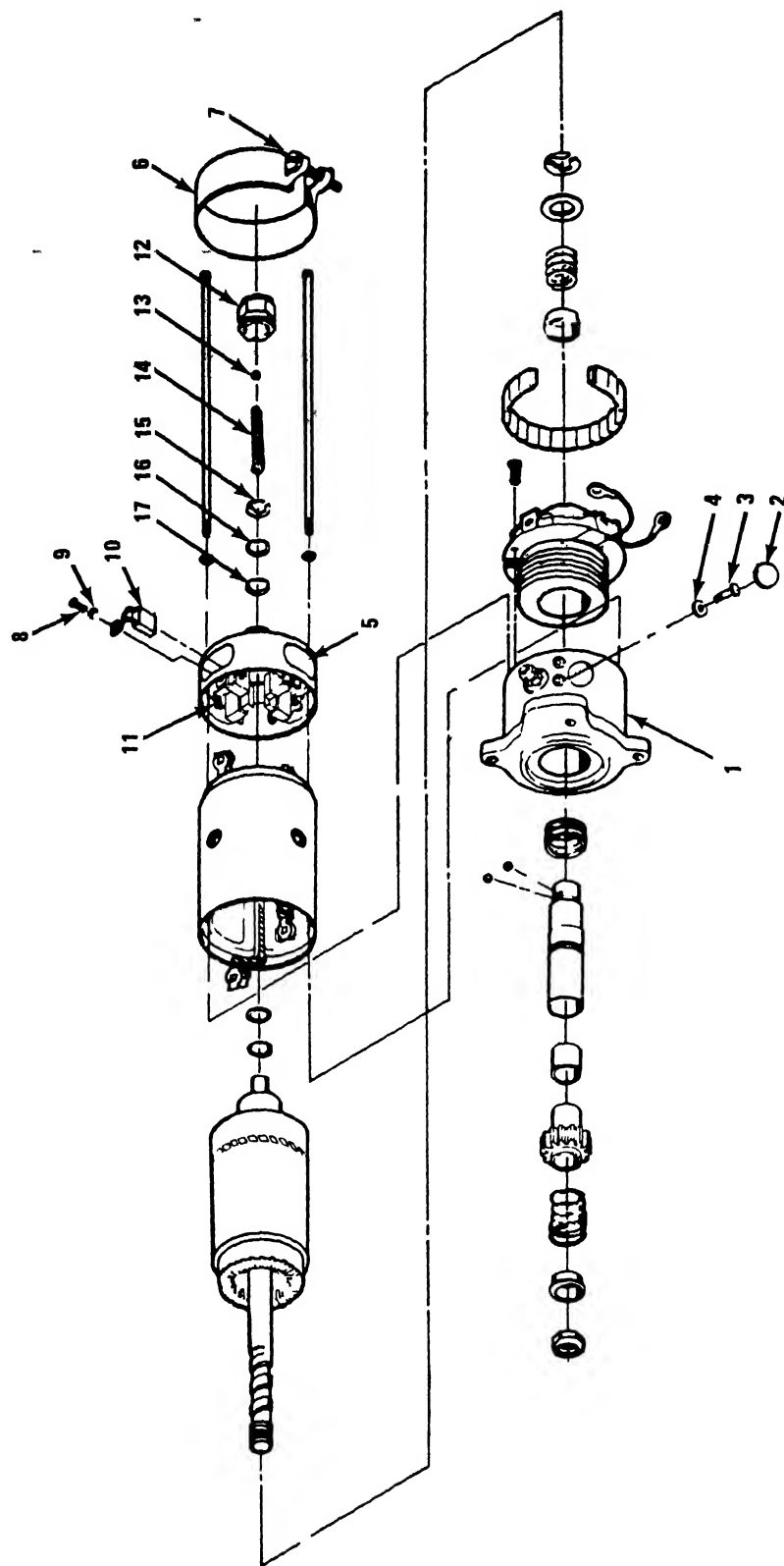
This task covers

- | | |
|----------------|-------------|
| a. Disassembly | d. Repair |
| b. Inspection | e. Assembly |
| c. Test | |

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Blind riveter	TM 5-1940-277-20	Starter motor removed from engine
Hammer, ball peen		
Drift pin		
Punch		
Ratchet		
5/16 in socket		
13/16 in socket		
Flat tip screwdriver, 6 in		
1-1/8 in box wrench		
Snap ring pliers		
Non-metallic hammer		
Long nose pliers		
Vise		
Vise jaw caps		
13/16 in box wrench		
1/2 in open end wrench		
Honing stone		
Cross tip screwdriver		
Armature test set		
Multimeter		
Generator, alternator and starter test stand		
Feeler gage		
Press		
Micrometer calipers, inside		
Bottle brush		
Lathe		
Air compressor		
Air blow gun		
Spring tester, resiliency		
Torque wrench (0 - 175 ft-lb)		
Safety goggles		
	Materials/Parts	
	Lubricator core plugs, drive end shield (1 each small, 2 each large)	
	Snap ring	
	Blind rivet	
	Solvent	
	Engine oil	
	Lapping paste	
	Fine sandpaper	
	Parafin	
	Brushes (set)	
	Grease	
	Crocus cloth	

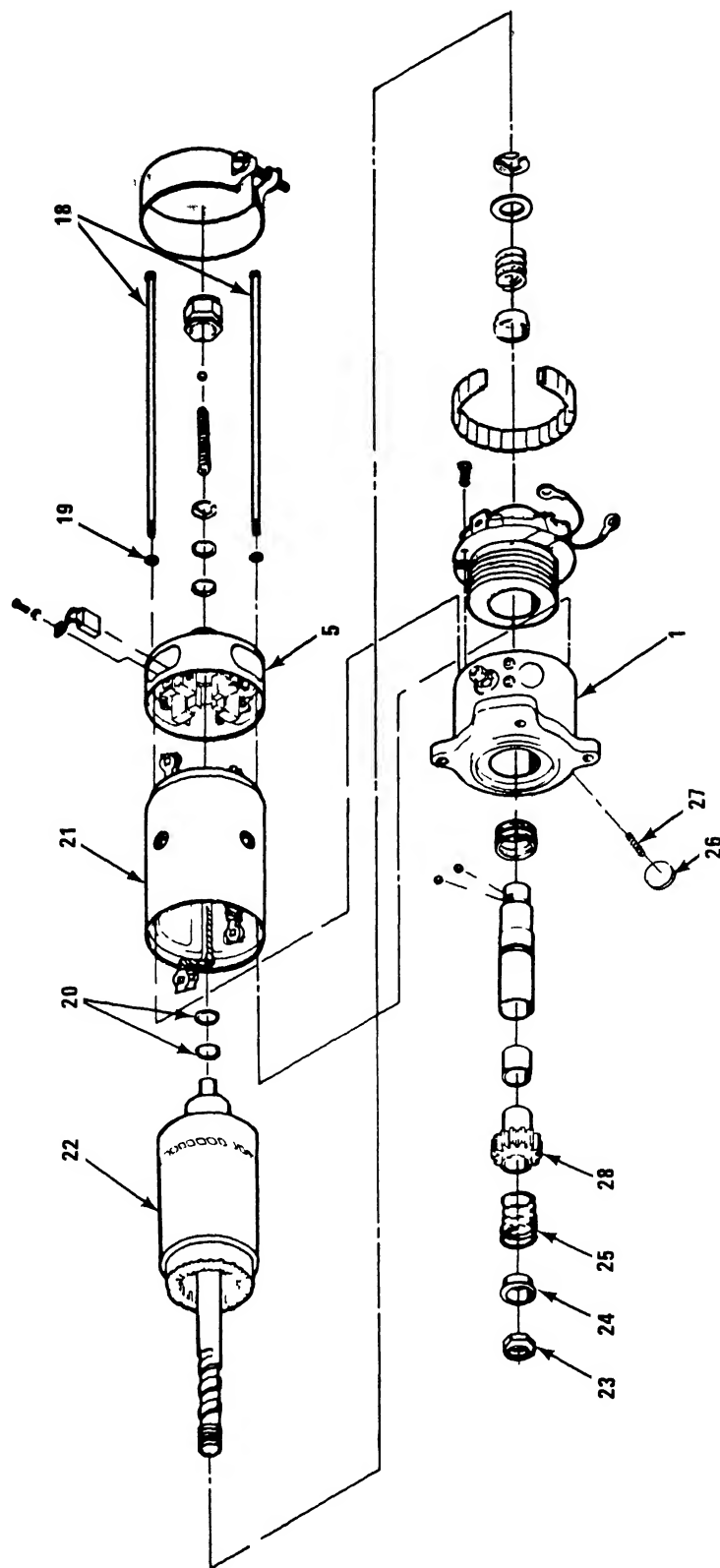
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
1 Drive end shield (1)	a. 2 core plugs (2)	Remove and discard	Use punch and ball peen hammer. Use new plugs when reassembling.
	b. 2 screws (3) and 2 lock-washers (4)	Unscrew and remove, releasing field terminal leads.	Use 5/16 in socket and ratchet.
2. Commutator end shield (5)	a Commutator cover (6)	Loosen fixing screw (7) and remove.	Use flat tip screwdriver
	b. 4 brush lead screws (8) and 4 lock-washers (9)	Remove, freeing brush lead	Use flat tip screwdriver
	c 4 brushes (10)	a Raise springs (11) and remove	
		b Discard	
	d End cap (12) and steel ball (13)	Remove	Use 1-1/8 in box wrench Be careful of steel ball (11) which is under spring pressure
	e Spring (14), snap ring (15), thrust washer (16), shim washers (17)	Remove	Use snap ring pliers

STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)

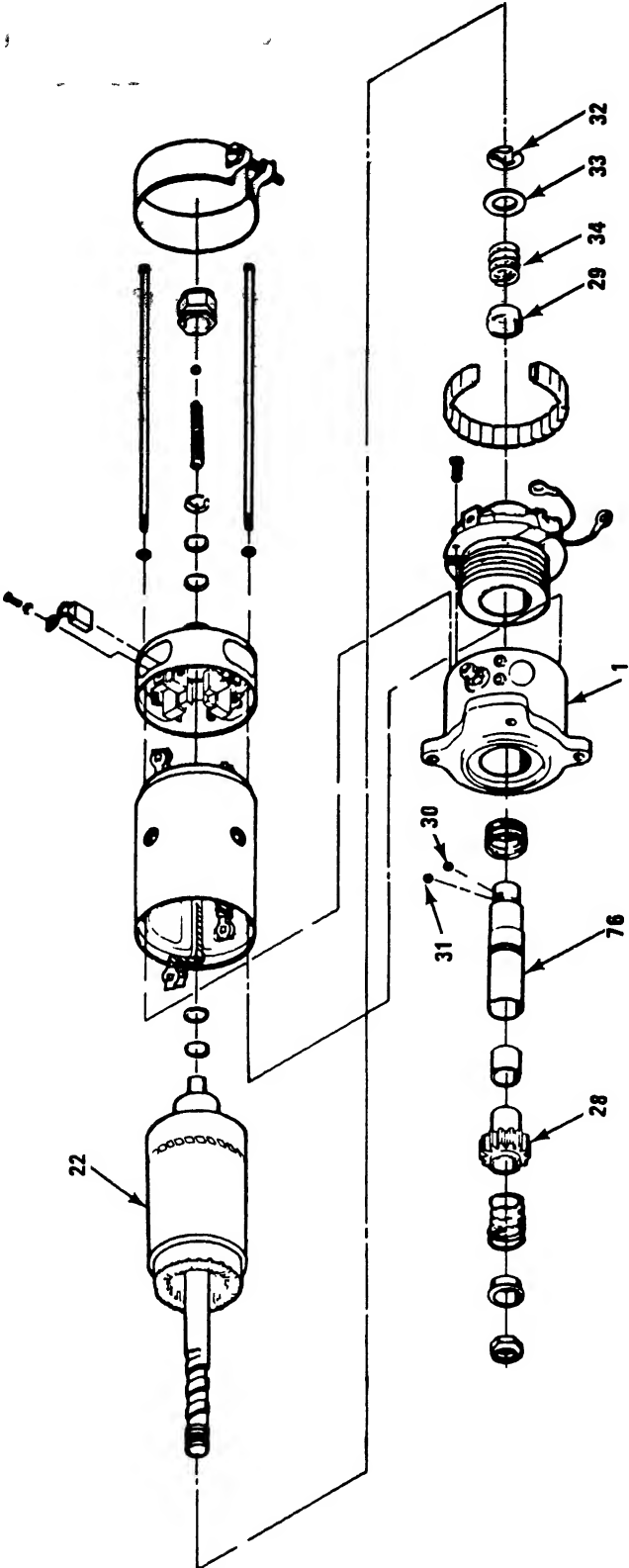


STARTER MOTOR REPAIR INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
	f. 2 through screws (18) and 2 washers (19)	Unscrew and remove	Use flat tip screwdriver
	g. Commutator end shield (5) and shim washers (20)	Tap lightly with non-metallic hammer and remove from end of armature shaft	Keep shims (20) to simplify end float adjustment upon reassembly.
3	Drive end shield (1)	a Drive end shield (1) with armature (22)	Use non-metallic hammer
		b Armature (22)	Mount in soft jawed vise
	c Pinion stop nut (23), thrust washer (24) and pinion spring (25)	Remove	Use 13/16 in box wrench
	d Lubricator core plug (26) and spring (27)	a Remove	Use punch and ball peen hammer
		b Discard plug	Use new plug when reassembling
	e Pinion (28) and drive end shield (1)	a Push end shield toward armature to release locking mechanism	

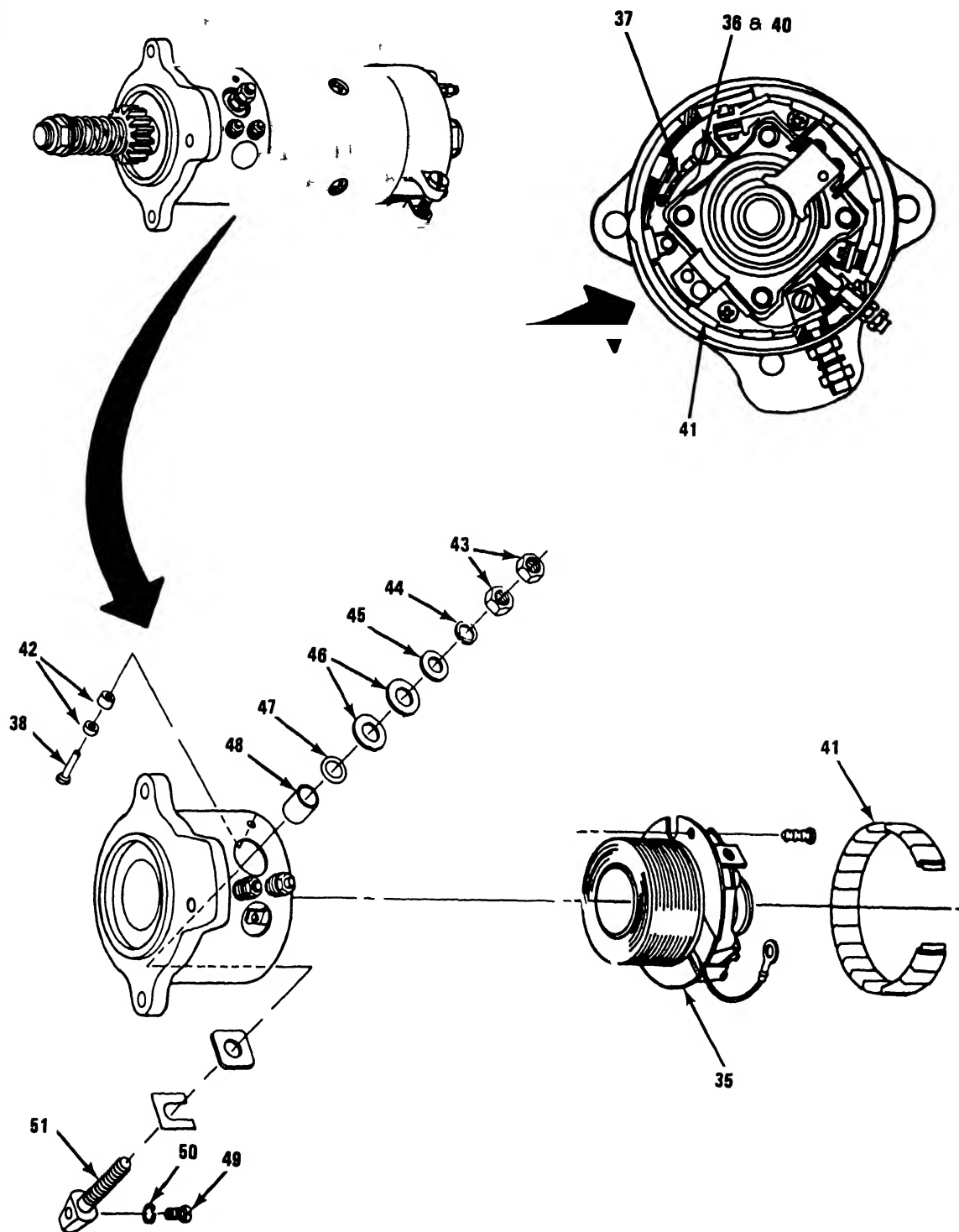
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. Hold lock collar (29) in this position	
		c. Unscrew pinion until helix disengages	
		d. Slide pinion and end shield off shaft	
		e. Collect 6 lock balls (30) and 4 overspeed balls (31)	
4	Armature (22)	Armature (22)	Remove from vise
5	Pinion (28)	a Snap ring (32), trip collar (33), lock collar spring (34), and lock collar (29)	Remove from end of pinion sleeve (76) Use snap ring pliers
		b Snap ring (32)	Discard
		c Pinion (28)	a Carefully remove any burrs on pinion Use honing stone
			b Withdraw from drive end shield (1)

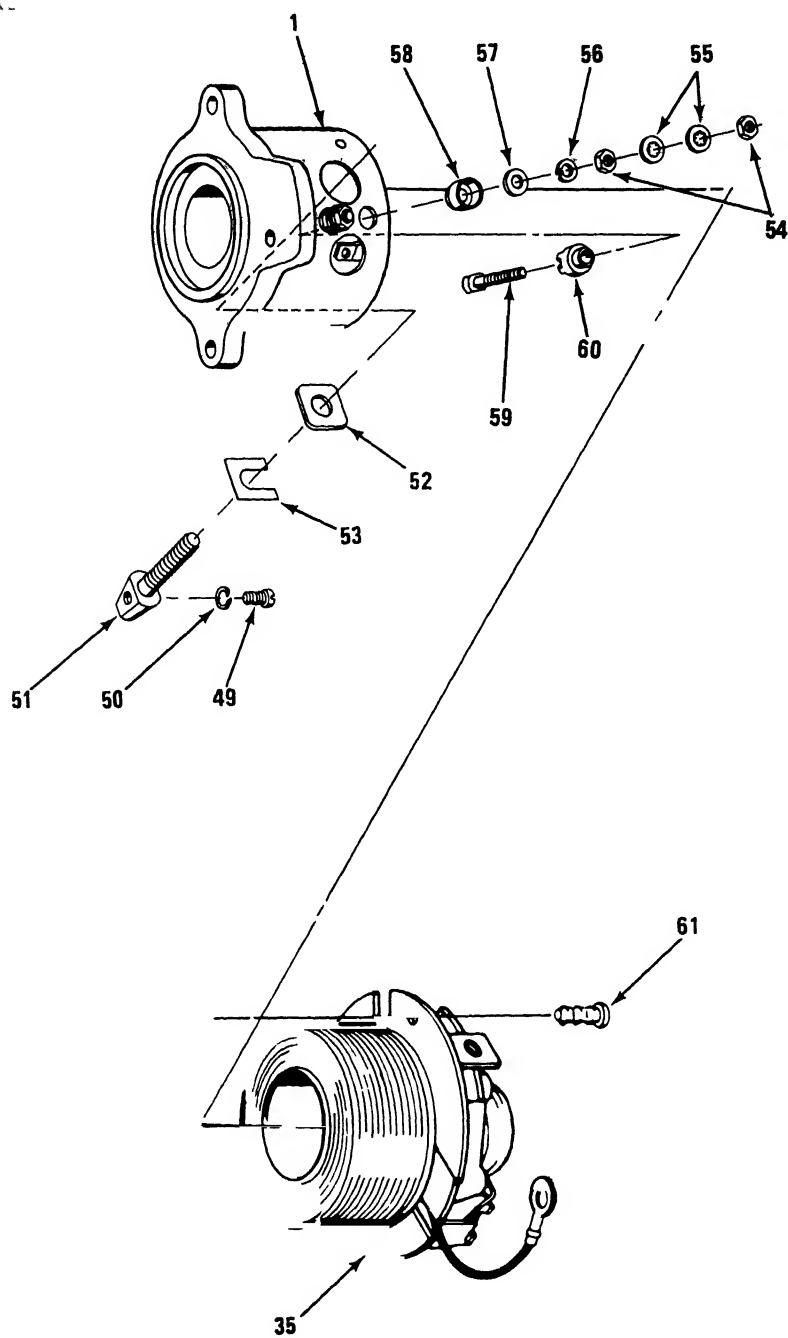
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
6 Solenoid (35)	Screw (36)	Remove and release resistor flexible lead (37).	Use flat tip screwdriver
7. Drive end shield (1)	a. Rivet (38)	Punch out.	Use punch and ball peen hammer.
	b. Resistor flexible lead (37)	Remove screw (36) and washer (40) Detach from solenoid.	Use flat tip screwdriver.
	c. Resistor (41) and 2 nylon bushings (42)	Remove	
	d. 2 nuts (43), lockwasher (44), plain washer (45), 2 insulating washers (46), rubber ring washer (47), and insulating bushing (48)	Remove	Use 1/2 in wrench
	e. Screw (49) and lockwasher (50)	Remove from inside drive end shield	Use flat tip screwdriver
	f. Main terminal (51)	Push in and remove from inside drive end shield	To make easier rotate terminal 180°

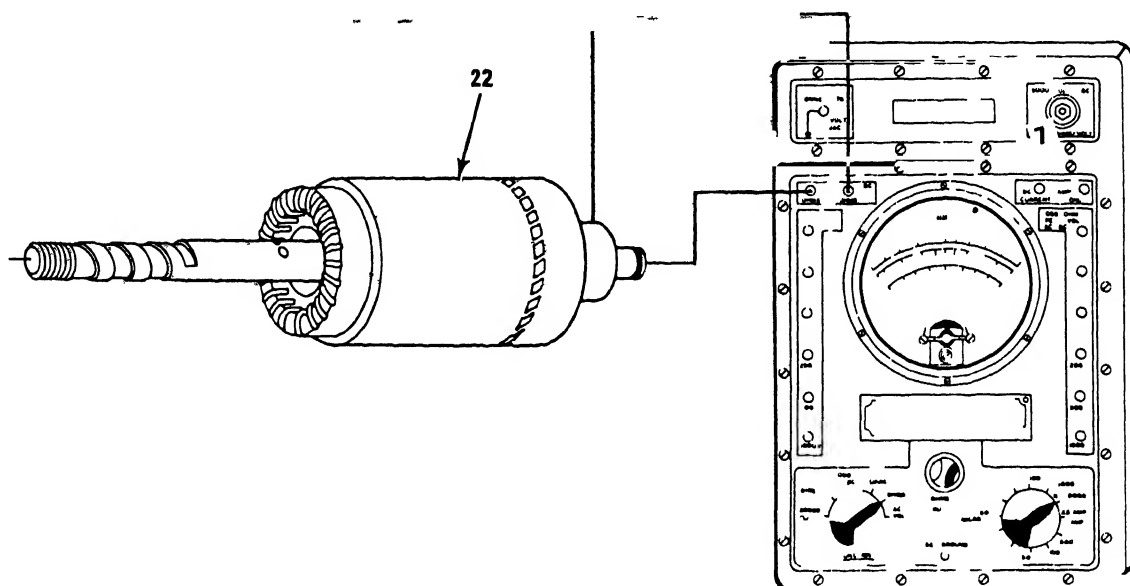
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



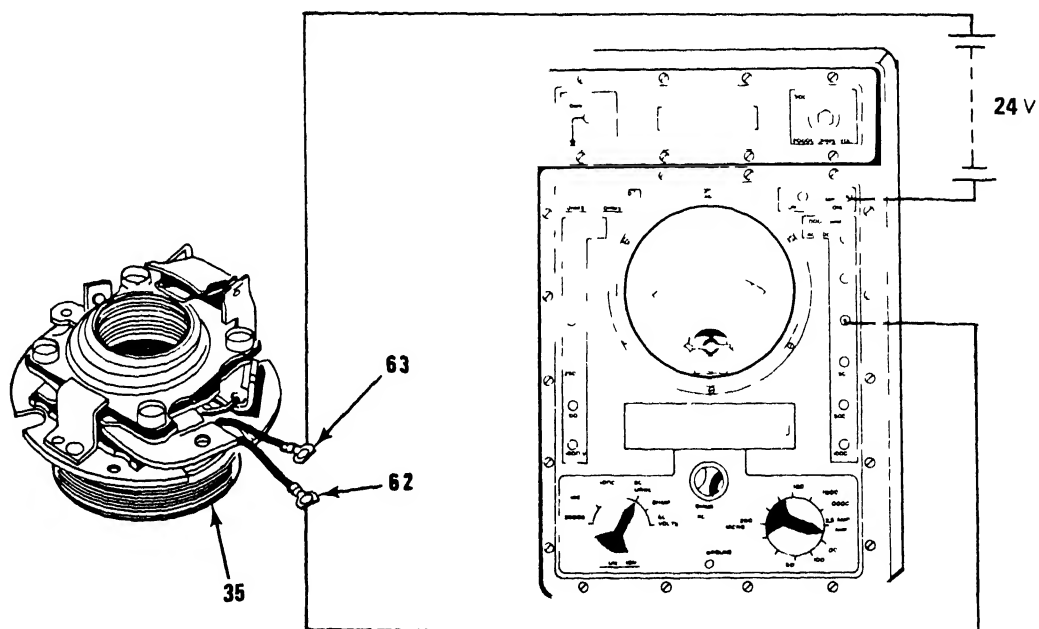
STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	g. Insulator (52) and anodized strip (53)	Remove off main terminal (51).	
	h. 4 nuts (54), 4 lockwashers (55), 2 lockwashers (56), 2 plain washers (57), and 2 insulating bushings (58)	Remove from solenoid terminals	Use 5/16 in open end wrench.
	i. 2 solenoid terminals (59)	Push well into and remove from inside drive end shield	
	j. Shaped insulating bushing (60)	Remove from solenoid terminal	
8 Solenoid (35)	a. 2 screws (61)	Remove	Use cross tip screwdriver
	b. Solenoid (35)	Withdraw from drive end shield	

STARTER MOTOR REPAIR INSTRUCTIONS (Continued)



ARMATURE INSULATION TEST

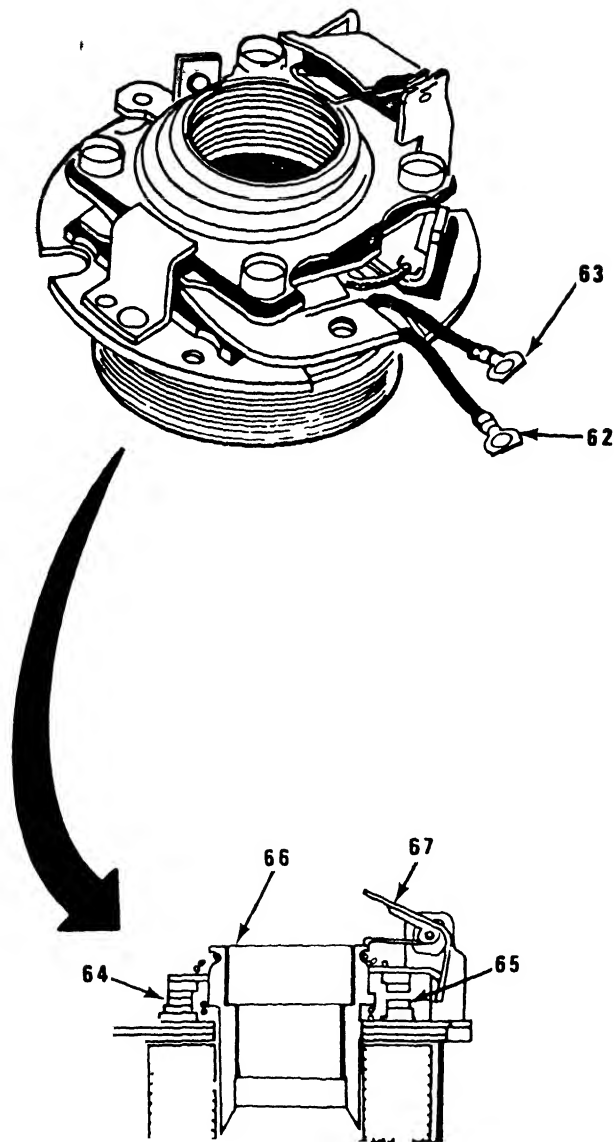


SOLENOID TEST

STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>INSPECTION AND REPAIR</u>			
9. Armature (22)	Armature (22)	<p>a Test windings for continuity and shorts</p> <p>b. Check insulation between commutator segments (70) and shaft Minimum resistance 1 megohm</p> <p>c Replace if defective</p>	<p>Use armature test set</p> <p>Use multimeter</p>
10 Solenoid (35)	Solenoid (35)	<p>a Test coils for short or open circuit by applying 24V to black (62) and yellow (63) leads Current consumption should be approx 19 amp</p>	<p>See figure for circuit</p> <p>Some starters will have green leads instead of yellow</p>

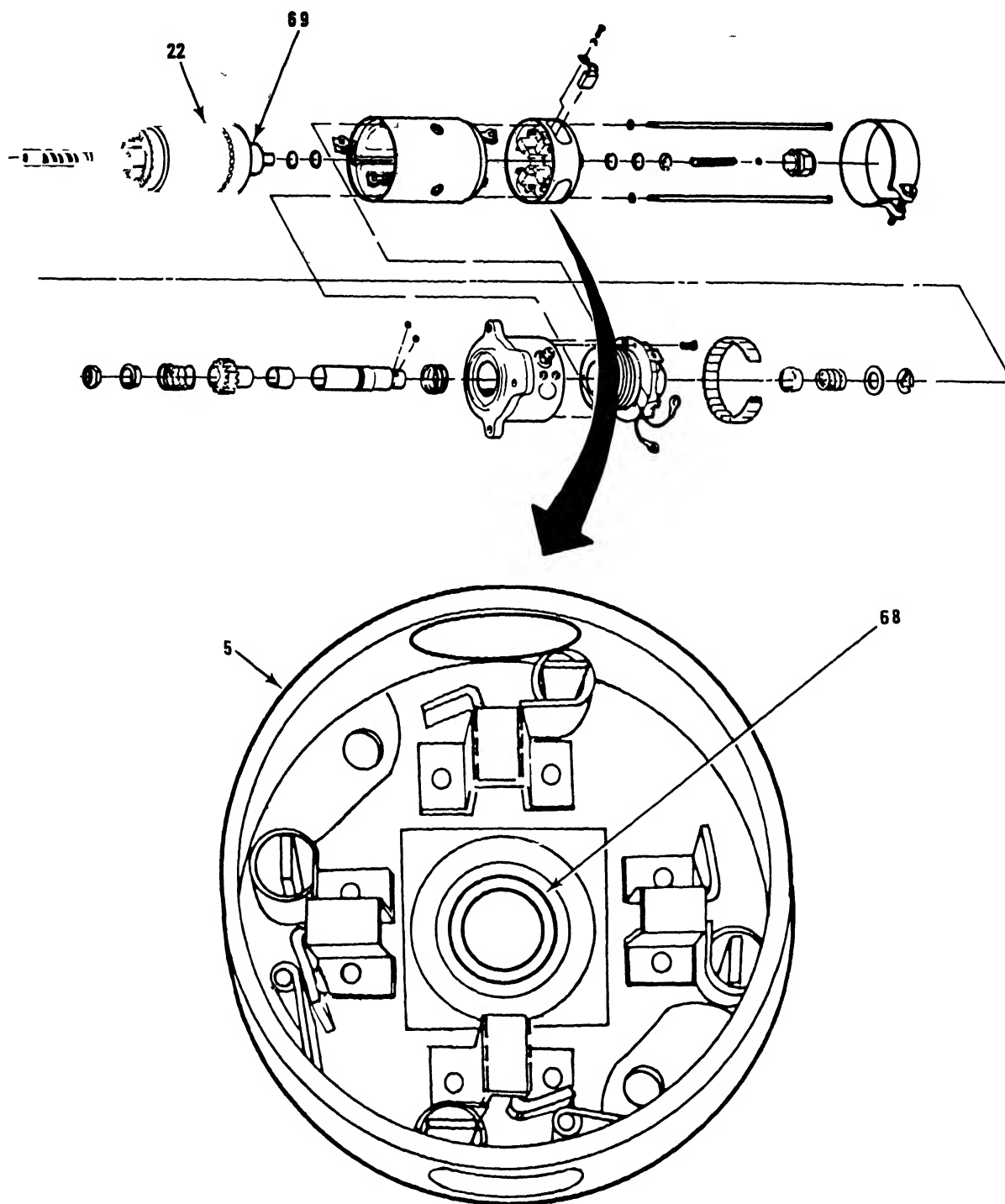
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. Check contacts (64) and (65) for cleanliness; Burnt spots; Overheated coil, Gap - 1st stage contact (56) (0.076 - 0.098 in) (0.193 - 0.249 mm)	Use feeler gage
		c Press down plunger (66) and check that 2nd stage contact (65) meets only after trigger (67) is tripped	
		d Clean dirty contacts	Use dry cleaning solvent and fine sandpaper
		e Replace complete solenoid if any defect is noted	

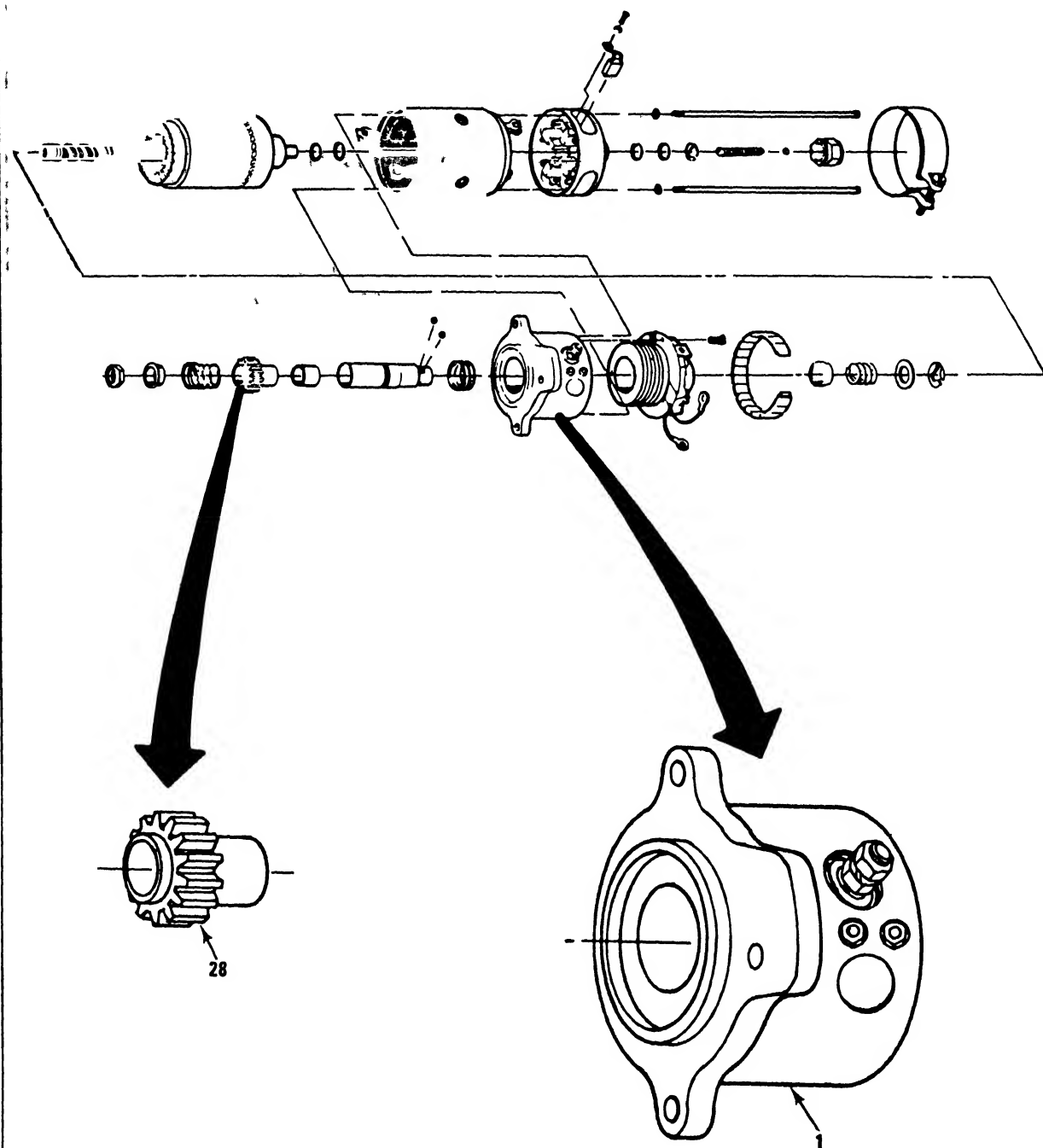
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
11. Commutator end shield (5)	Commutator end bearing (68)	<p>a. Check that bearing (68) is tight in its housing</p> <p>b. Check side play between armature shaft (69) and bearing (68).</p> <p>c. Replace bearing if side play exists or fit in housing not tight,</p> <ul style="list-style-type: none"> ● Press bearing out of end shield Use hand press. ● Smear new bearing lightly with oil ● Press new bearing into end shield ● Measure bore Use micrometer calipers, inside 	

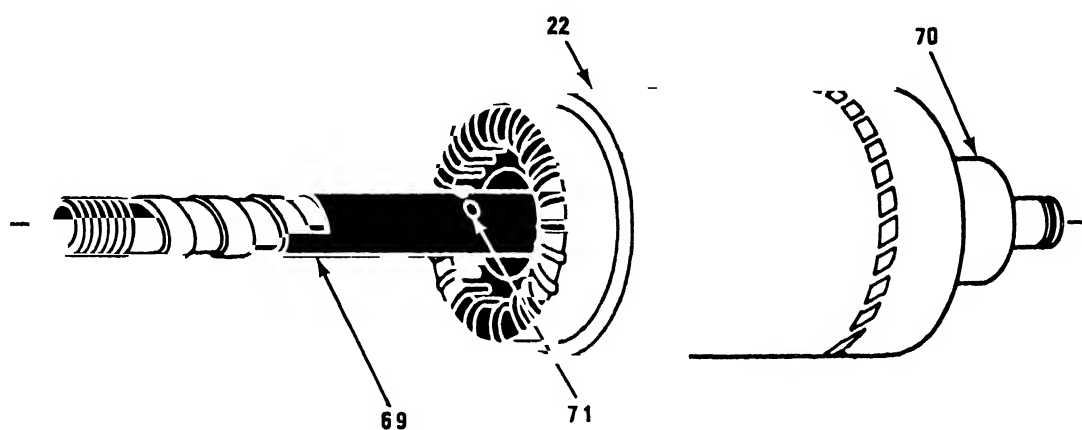
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
12. Drive end shield (1)	Drive end shield bearing	<p>a. Measure internal diameter tolerance 1 127 -0 +0 0007 in.</p> <p>b. Replace with new drive end shield assembly if bearing worn</p>	Use micrometer calipers, inside.
13. Pinion (28)	Pinion (28)	<p>a. Replace if teeth badly worn or chipped</p> <p>b. Check that pinion slides freely on armature shaft</p> <p>c. If necessary for fit, lightly lap the pinion and shaft</p> <p>d. Remove all traces of lapping paste</p>	<p>Make sure new pinion has same number teeth as old pinion</p> <p>Use fine lapping paste</p> <p>Use a bottle brush to ensure absolute cleanliness</p>

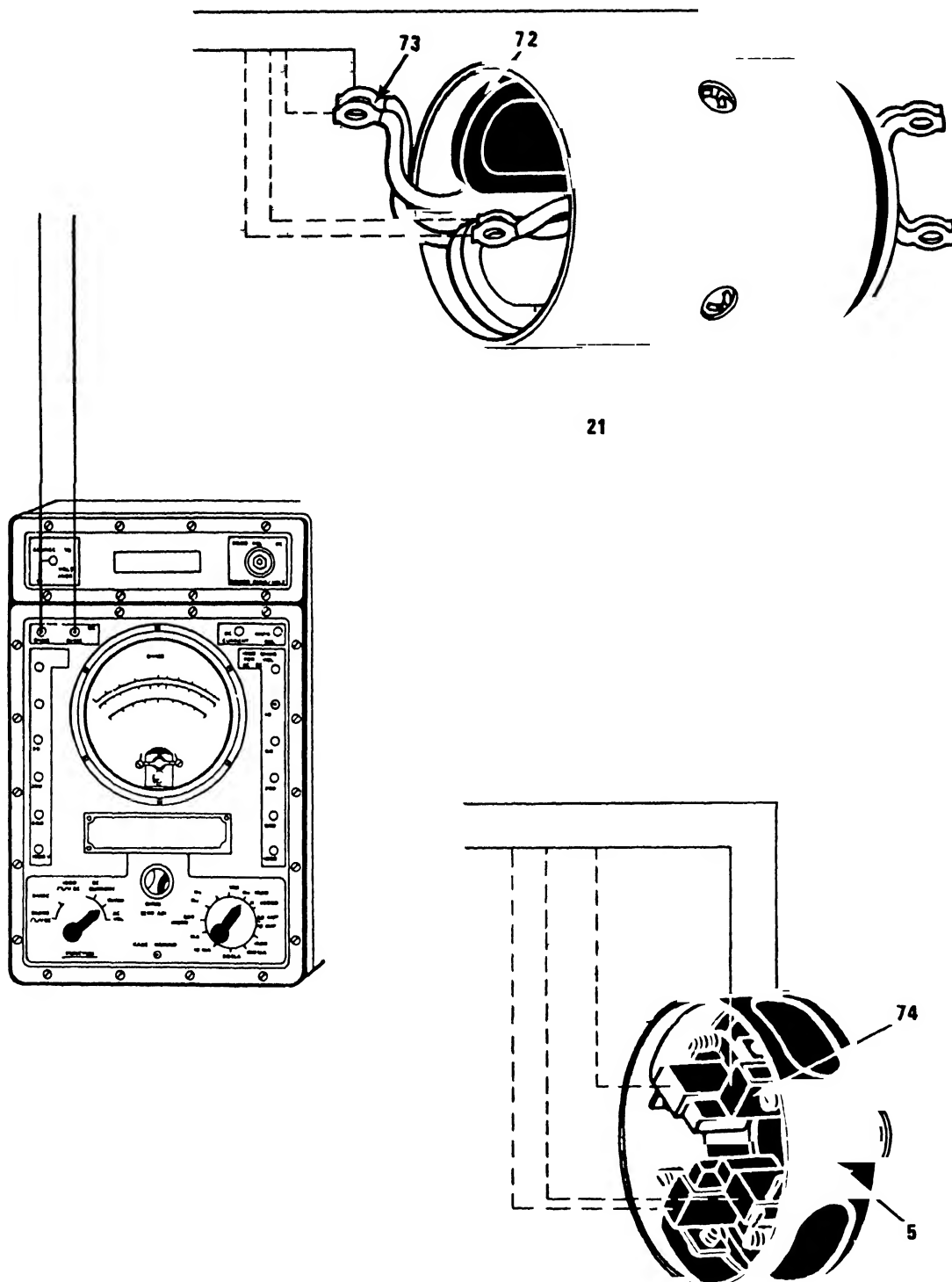
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS	
14	Springs (see chart below)	a Check for bending or breaking b. Test for ten- sion strengths as follows c Replace if outside limits	Use spring resiliency tester	
SPRING		COMPRESSED LENGTH	TENSION	
Lock spring (34)		0 375 in (9 53 mm)	1 69 to 1 94 lb (0 765 to 6 878 kg)	
Recoil spring (14)		1 313 in (33 35 mm)	26 5 to 29 5 lb (12 0 to 13 39 kg)	
Pinion spring (25) (oil sealed starter)		1 469 in (37 3 mm)	9 81 to 10 19 lb (4 4 to 4 6 kg)	
Brush spring (11)		Raise to height of installed brush	6 0 to 7 5 lb (2 7 to 3 4 Kg)	
15	Armature (22)	Commutator (70)	a Clean dirty or discolored surface b If badly pitted or grooved replace armature	Use crocus cloth
16	Armature (22)	Armature (69) shaft	a Remove burrs in lock ball recesses (71) if necessary	Use honing stone

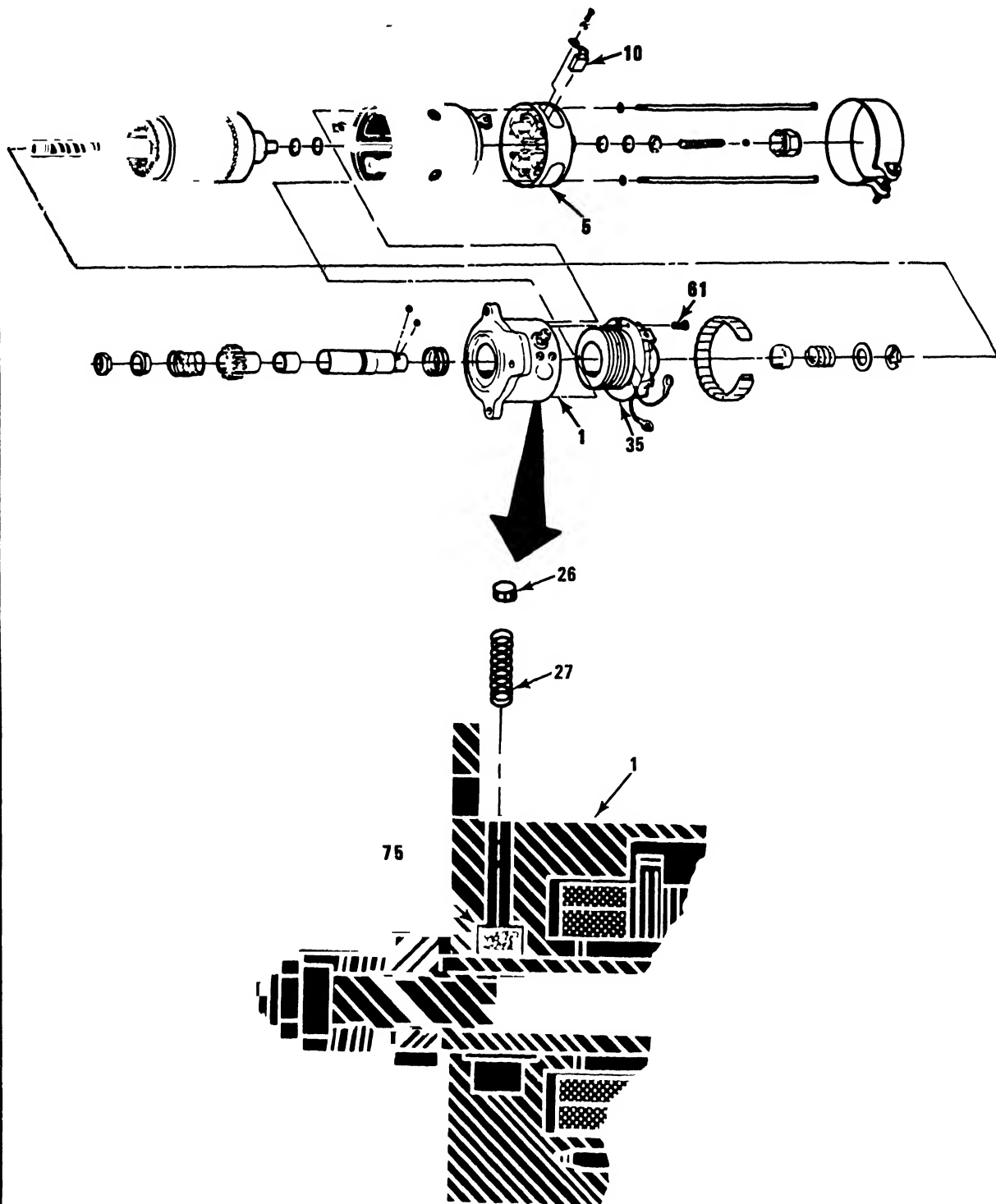
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. Remove burrs on helices if necessary.	Use honing stone
		c. Clean helices	Use parafin.
		d. Smear helices with small quantity of grease	
		e. Replace if helices chipped	
17 Yoke (21)	Field windings (72)	a. Test insulation between poles (leads) (73) and yoke (21) Min resistance 1 megohm	Use multimeter.
		b. Try new stator if shorts in coils are suspected.	Resistance of coils is very low making it hard to test for shorts
		c. Replace stator if shorts are detected	
18 Commutator end shield (5)	Brush gear	a. Test insulation between brush holders (74) and frame of commutator end shield (5) Min resistance 1 megohm	Use multimeter

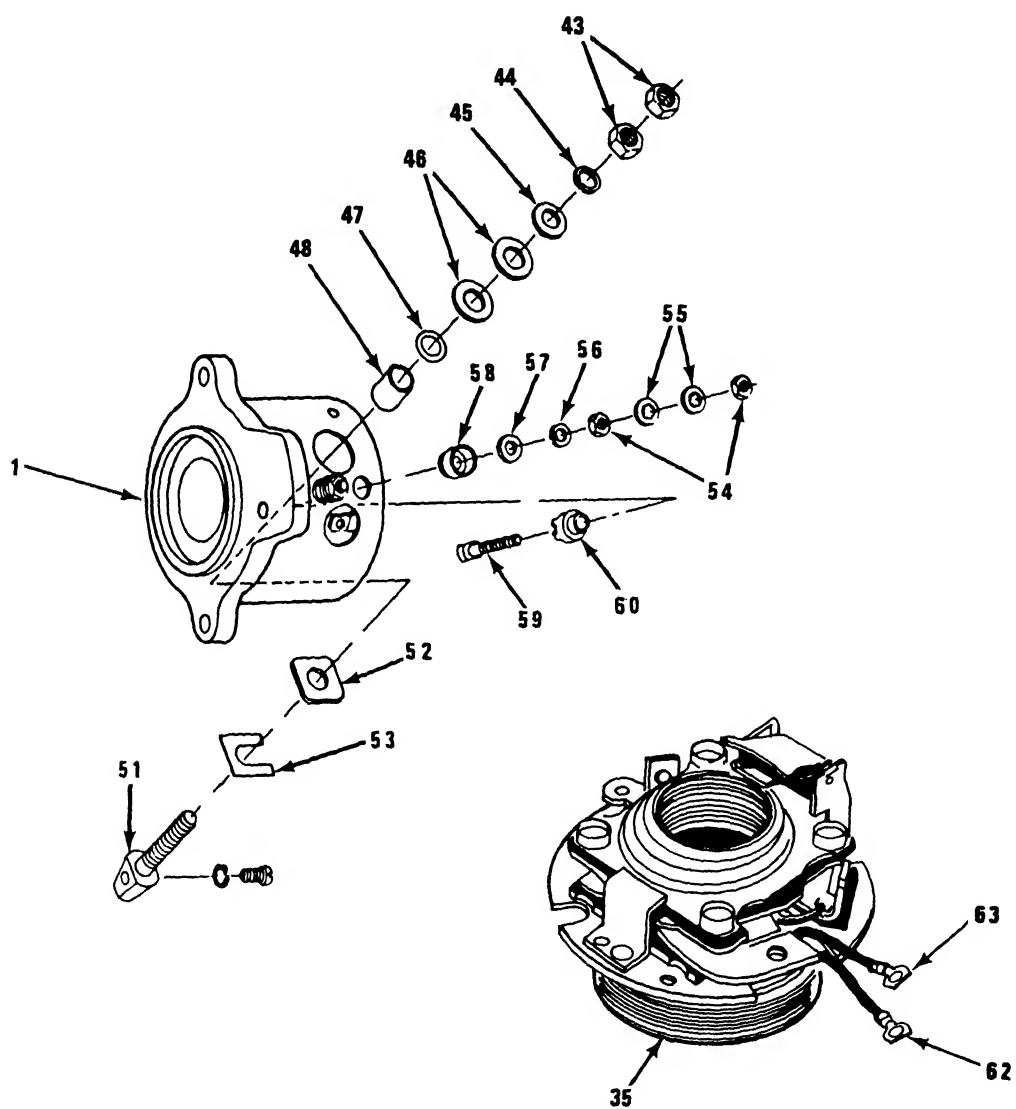
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. Replace commutator end shield if defective	
19. Commutator end shield (5)	Brushes (10)	Replace as a set to give maximum serviceable life after repair.	
<u>ASSEMBLY</u>			
20. Drive end shield (1)	a Drive end shield (1)	a On new end shield remove leatheroid retaining pad from oil way	Important - new end shields come with leatheroid retaining pad fitted in oil way If pad is not removed bearing will be oil starved
		b Check that felt pad (75) is free to move under influence of spring	
		c Remove lubricator core plug (26) and spring (27)	Spring pressure on felt pad (75) will prevent pinion sleeve being fitted
	b Solenoid (35)	Insert in drive end shield	
	c. Two screws (61)	Install to secure solenoid.	Use cross tip screwdriver.

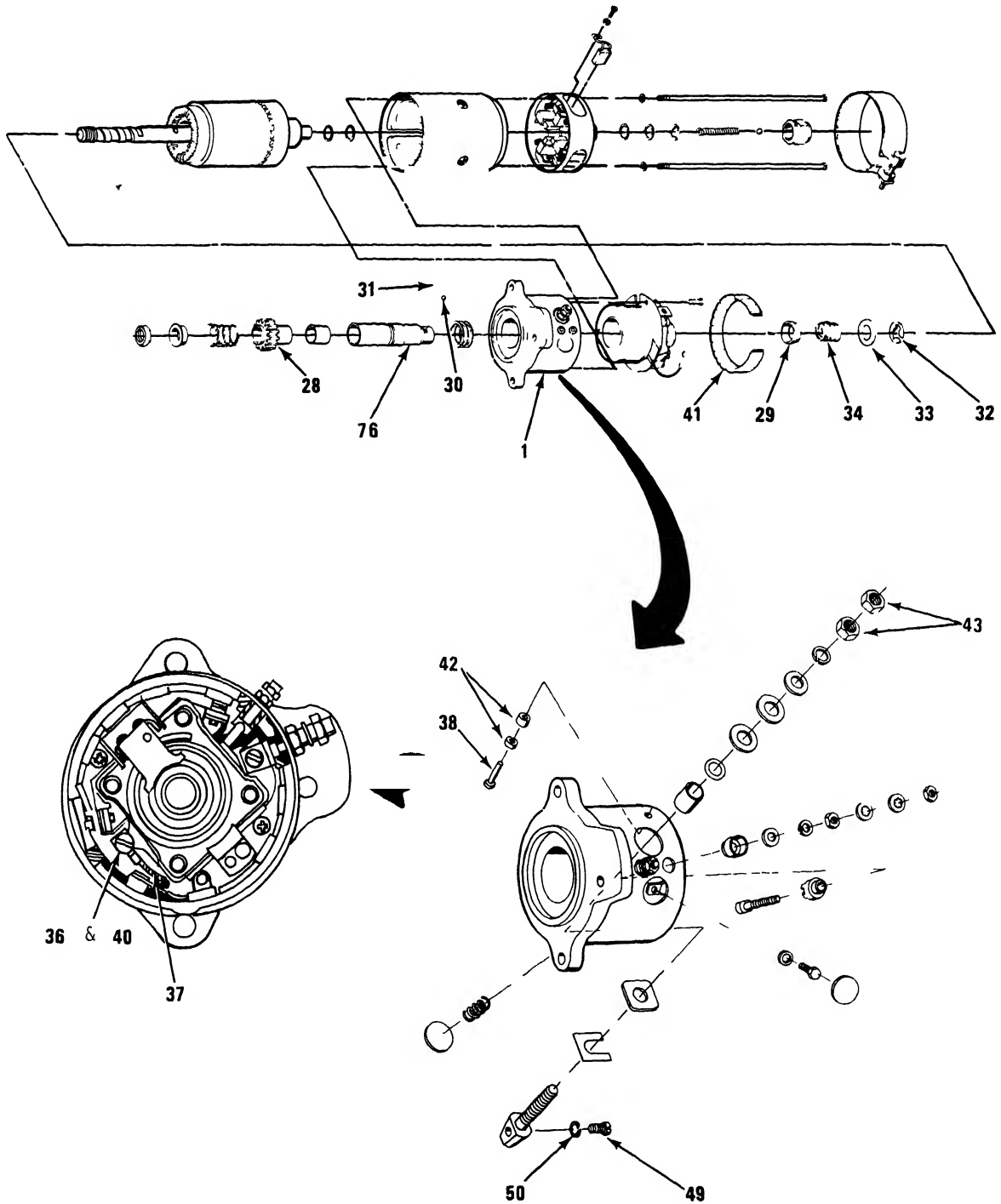
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	d. Anodized metal strip (53)	Drop in place on inside face of main terminal insulator (52).	
21 Solenoid terminals (59)	a. 2 shaped insulator bushings (60) and terminal tag	Place over terminal screw	Yellow lead goes on terminal closest to open end of drive end shield
	b. 2 terminals (59)	Push through hole in end shield	
	c. 2 round insulating bushings (58), 2 washers (57), 2 lockwashers (56), 4 nuts (54) and 4 lockwashers (55)	Fit on terminal screw	Use 5/16 in wrench.
22 Drive end shield (1)	Main terminal (51)	Insert into position from inside housing through anodized metal strip (53) and insulator (52).	Depress solenoid plunger for room to insert terminal
23 Main terminal (51)	a. Insulating bushing (48), rubber ring (47), 2 insulating washers, (46), plain washer (45), lockwasher (44), and 2 nuts (43)	a. Fit on terminal b. Screw nut on finger tight	

STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)

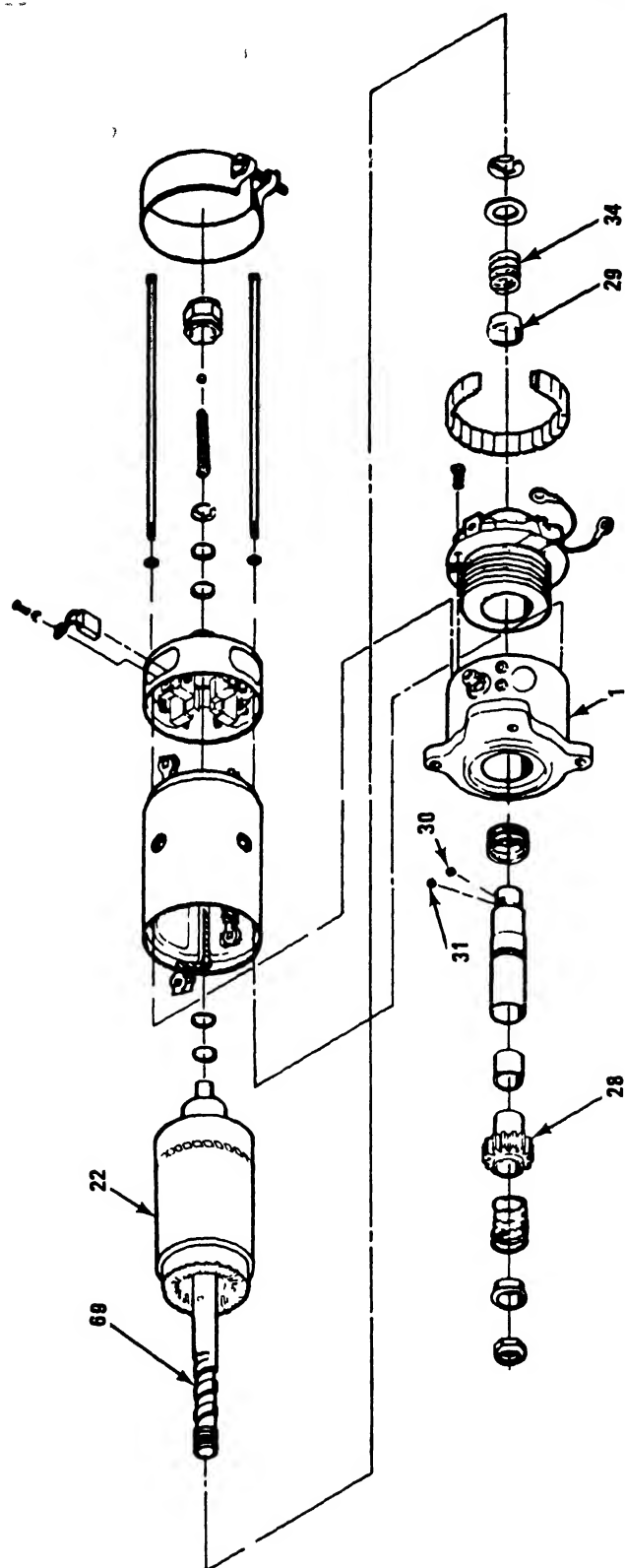


STARTER MOTOR REPAIR INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
	b. Screw (49) and lock-washer (50)	Install and tighten	Use flat tip screwdriver
	c Nut (43)	Tighten.	Use 1/2 in open end wrench
24 Pinion (28)	a Lock collar (29)	Fit to pinion sleeve	Make sure 45° chamfer, inside collar, faces solenoid
	b Spring (34), trip collar (33), new snap ring (32)	Fit to sleeve	Make sure snap ring seats squarely in locking groove
25 Drive end shield (1)	a Resistor (41), bushing spacers (42), rivet (38)	Insert in recess in shield Secure resistor and bushing spacers with rivet	Use blind riveter
	b Resistor lead (37), washer (40) and screw (36)	Secure lead to lug on solenoid moving contact using washer and screw	Use flat tip screwdriver
26 Pinion sleeve (76)	6 lock balls (30) and 4 over-speed balls (31)	Insert balls into pinion sleeve holes	Use small screwdriver with spot of grease to feed in balls. Hold in place with smear grease

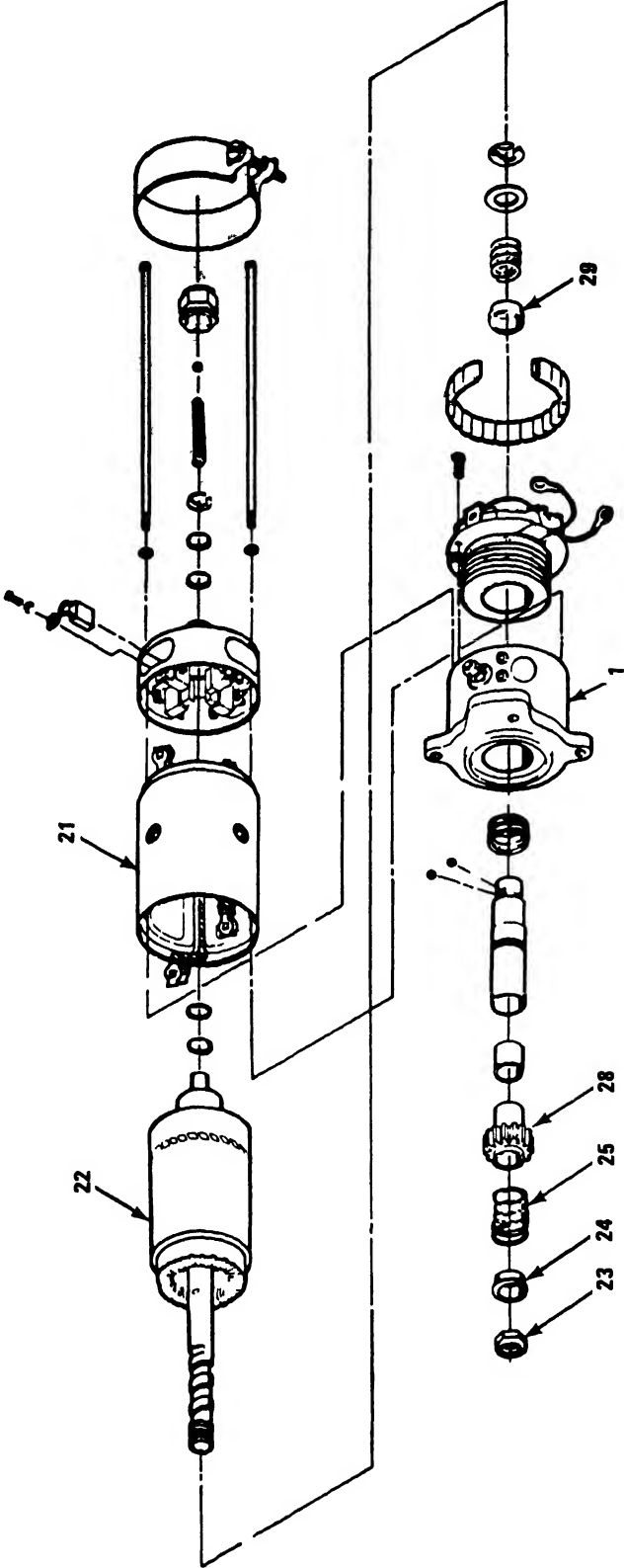
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
27. Armature (22)	Pinion (28), drive end shield (1) and armature (22)	Assemble pinion and drive end shield to the armature as follows	
	a Pinion (28) and drive end shield (1)	a Pull pinion out drive end shield until lock collar (29) is pressed against spring (34) by solenoid plunger.	
		b Hold in this position until helix is engaged (step 27d below)	
	b Lock balls (30) and overspeed balls (31)	Press fully in holes	
	c Pinion (28) and drive end shield (1)	Slide pinion and drive end shield onto armature shaft (69)	Take care not to displace balls
	d Pinion (28)	a Engage helix	
		b Release pull on pinion (28).	
		c Screw pinion onto helix	

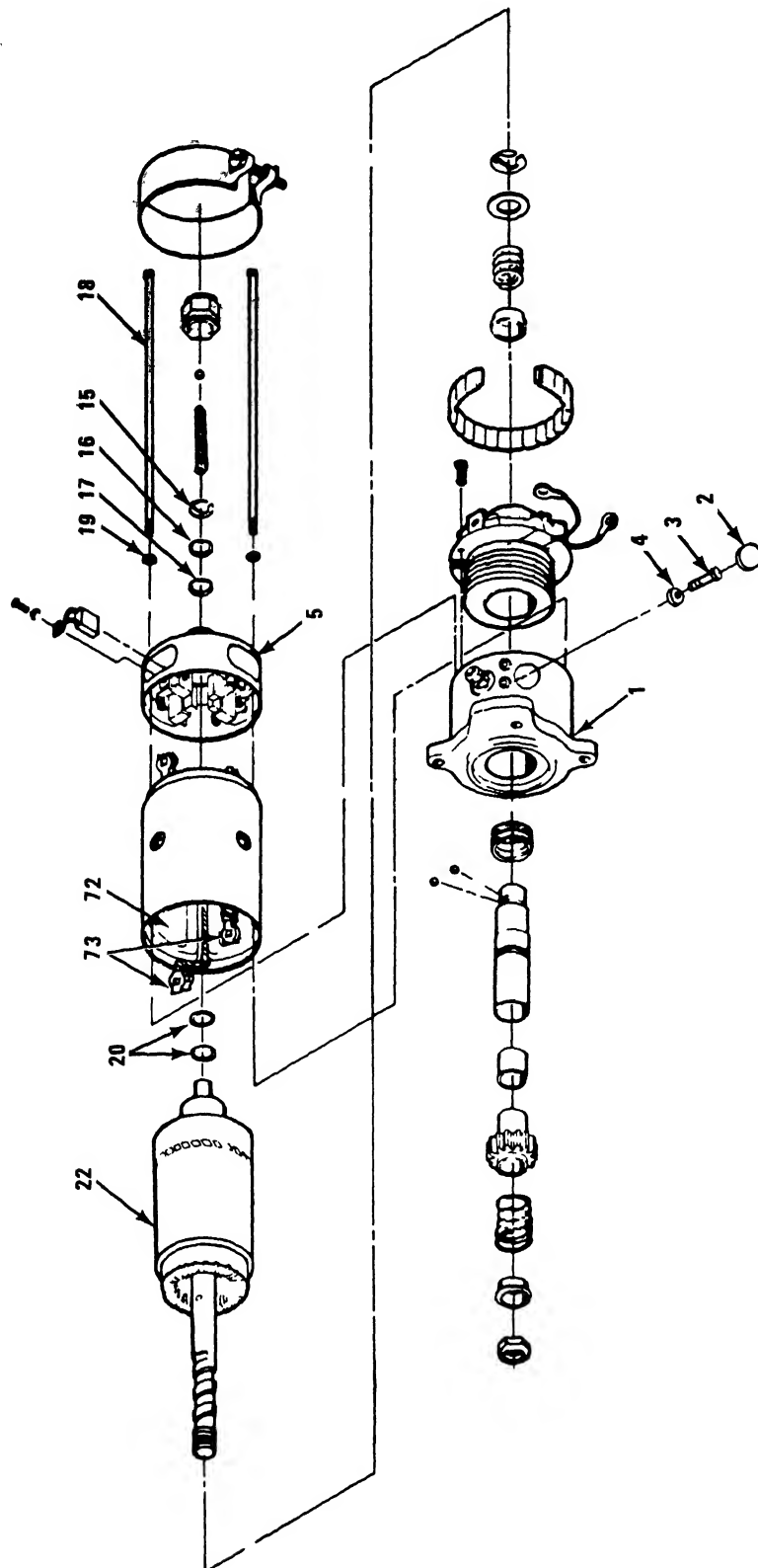
STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR NS NS NS (Continued)

LOCATION	ITEM	ACTION	REMARKS
28 Pinion (28)		d. Check that pinion locking mechanism engages	
	a Locking collar (29)	Release locking mechanism, pull collar back against spring	
	b. Pinion (28)	Check that it is free on shaft, support end shield and rotate pinion both directions	
29 Armature (22)	a. Armature (22)	Mount in soft jawed vise	
	b Pinion return spring (25) and thrust washer (24)	Assemble onto pinion shaft	
	c Pinion stop nut (23)	a Screw onto shaft b Torque to 40 to 50 ft-lb (5.6 to 6.9 kg-m)	Use 13/16 in socket and torque wrench
30. Yoke (21)	Armature (22) and drive end shield assembly (1)	a Assemble to yoke (21)	Make sure yoke dowel locates in shield slot

STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)

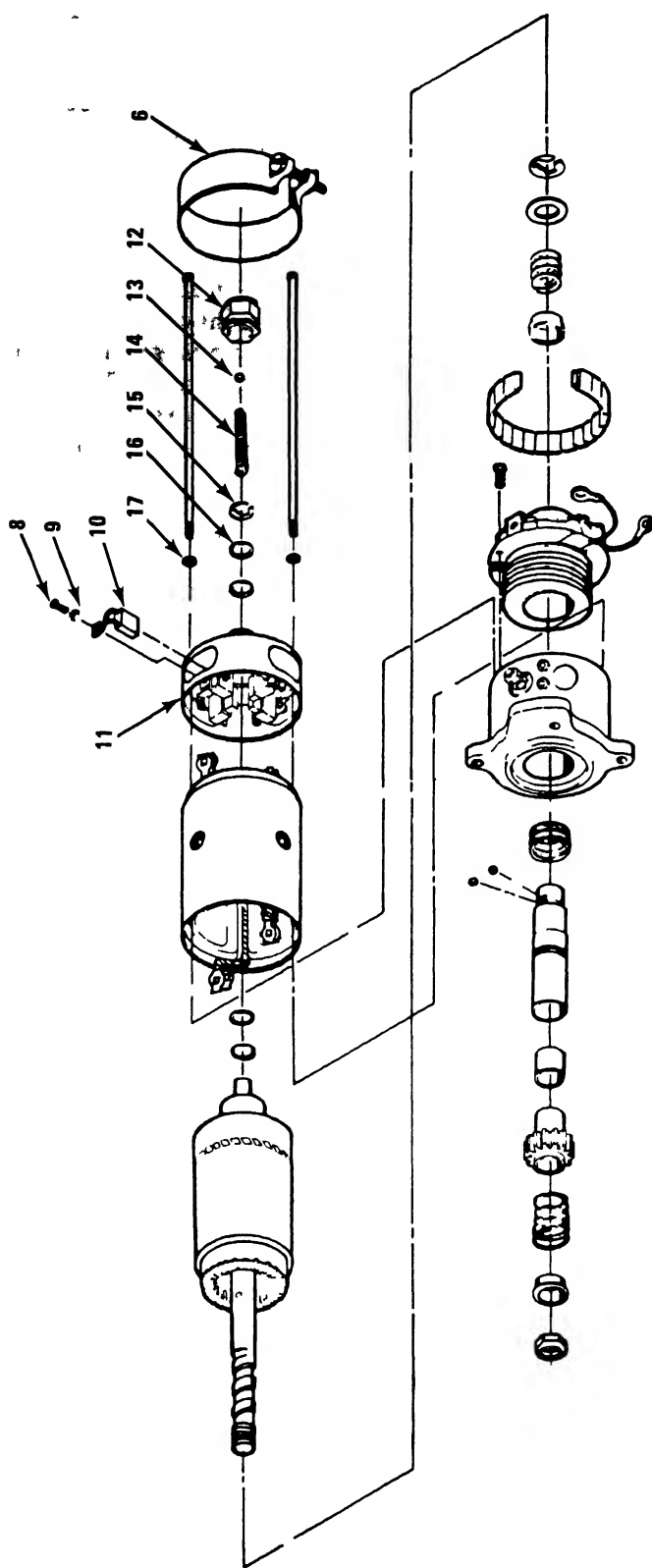


STARTER MOTOR REPAIR INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. Seal joint between	Smear joint with light coat of grease.
31. Armature (22) and drive end shield assembly (1)	a 2 screws (3), 2 lockwashers (4) and 2 (new) core plugs (2)	a. Install washers and screws securing tags (73) from field windings (72)	Use 5/16 in socket and ratchet
		b. Install core plugs sealing opening in drive end shield.	Use drift pin and ball peen hammer
	b Shim washers (20)	Fit original washers on armature shaft	
	c Commutator end shield (5)	Fit onto shaft	
	d 2 through screws (18) and washers (19)	Insert and tighten	Use flat tip screwdriver
32 Starter	a Starter	Hold vertically with commutator end shield up	
	b Shim washers (17)	Fit original washers onto shaft	
	c. Thrust washers (16)	Fit onto shaft	

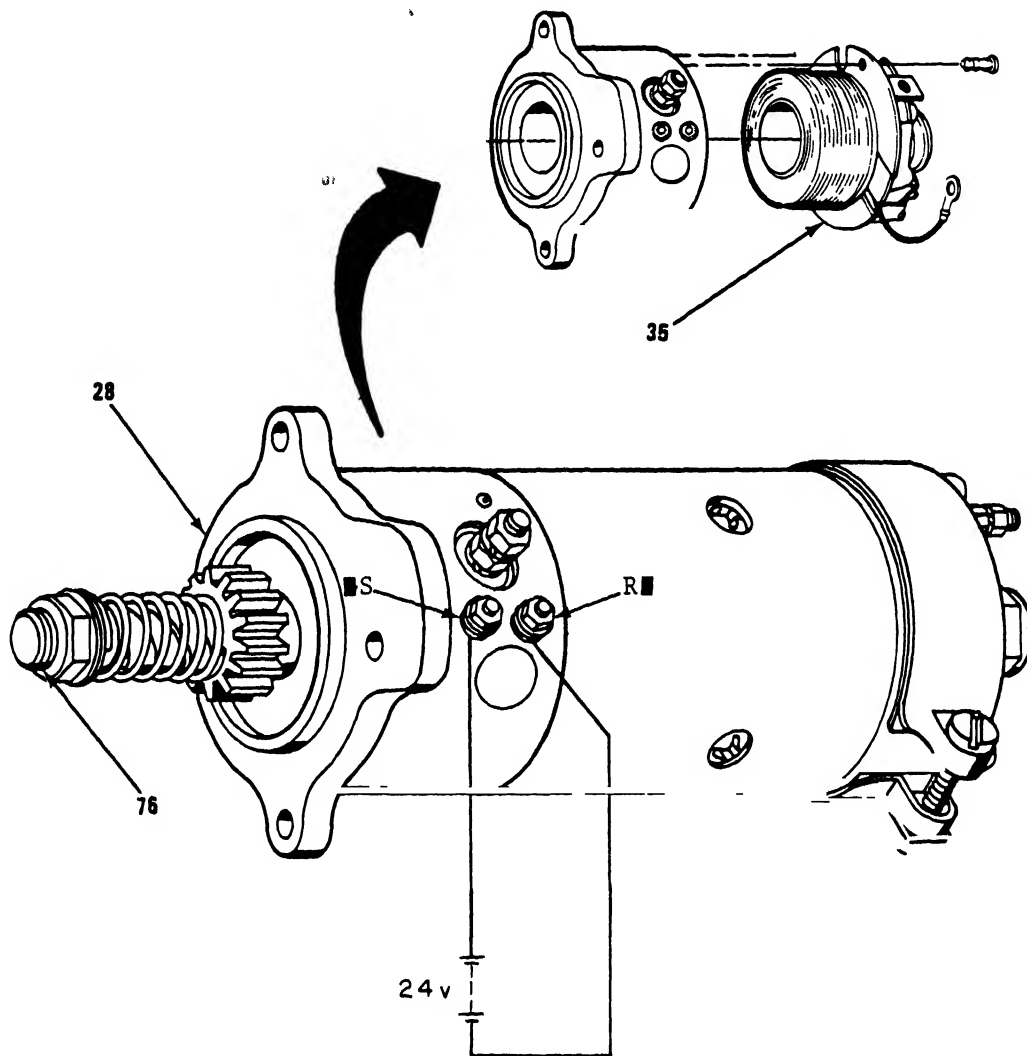
STARTER MOTOR REPAIR INSTRUCTIONS
(Continue)



STARTER MOTOR REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	d. Snap ring (15)	Fit onto shaft.	Use snap ring pliers.
	e. Spring (14) and ball (13)	a Smear with grease. b Insert in bore in armature shaft	
	f. End cap (12)	Screw onto end of armature shaft.	Use 1-1/8 in box wrench
	g. 4 new brushes (10)	Raise spring (11) and install	Use screwdriver
	h 4 brush lead screws (8) and 4 lock-washers (9)	Install securing brush leads	Use flat tip screwdriver
	i Commutator end shield cover (6)	Install and tighten	Use flat tip screwdriver

STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)



STARTER MOTOR REPAIR INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>BENCH TEST</u>			
NOTE			
Use automotive generator, alternator and starter test stand, reference TM 9-4910-458-12			
	Solenoid (35)	a. Pull pinion (28) forward by hand (approx 0 0625 in)	
		b Release	Pinion should return to original position
		c Apply battery voltage of 24 volts between S and R terminals	a Battery should be well charged b Pinion (28) should move forward 0 25 in (6 3 mm)
		d With solenoid energized (c above) draw pinion forward by hand, rotating clockwise	Pinion locking mechanism should lock pinion in forward position
		e Disconnect battery Pinion (28) must return to disengaged position in one sharp movement	

STARTER MOTOR REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		f Apply compression spring tester force to drive end of shaft (76)	Shaft should not move backward until 30-38 lb. (13.6 to 17.2 kg) force applied (check recoil spring).

TURBOCHARGER REPAIR INSTRUCTIONS

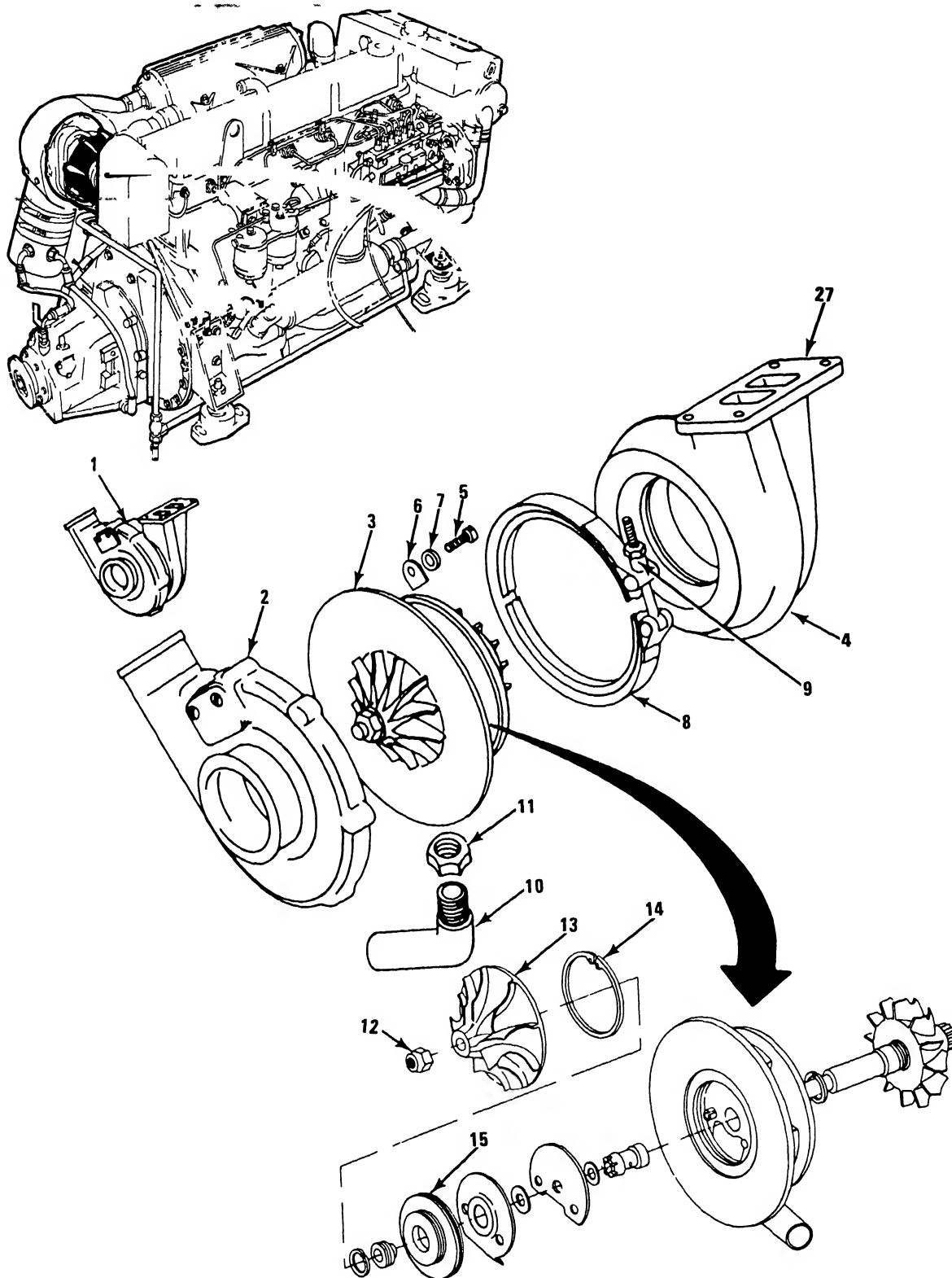
This task covers

- a. Disassembly
- b. Inspection and Repair
- c Assembly

INITIAL SETUP

Tools	Equipment Condition	Condition Description.
Ratchet 7/16 in socket Scribe 1-1/4 in box wrench 1/2 in box wrench Two 7/16 in open end wrenches, 6 in Two flat tip screwdrivers Snap ring pliers Air compressor with air gun Safety goggles Bristle brush Wire brush Putty knife	TM 5-1940-277-20	Turbocharger removed from engine.
Materials/Parts		
Overhaul kit		
O-ring		
Thrust ring		
Thrust plate		
Thrust washer		
Bearing		
Piston ring (2 each)		
Lockwashers		
Snap ring		
Solvent		
Engine oil		
Plastic scraper		
Crocus cloth		

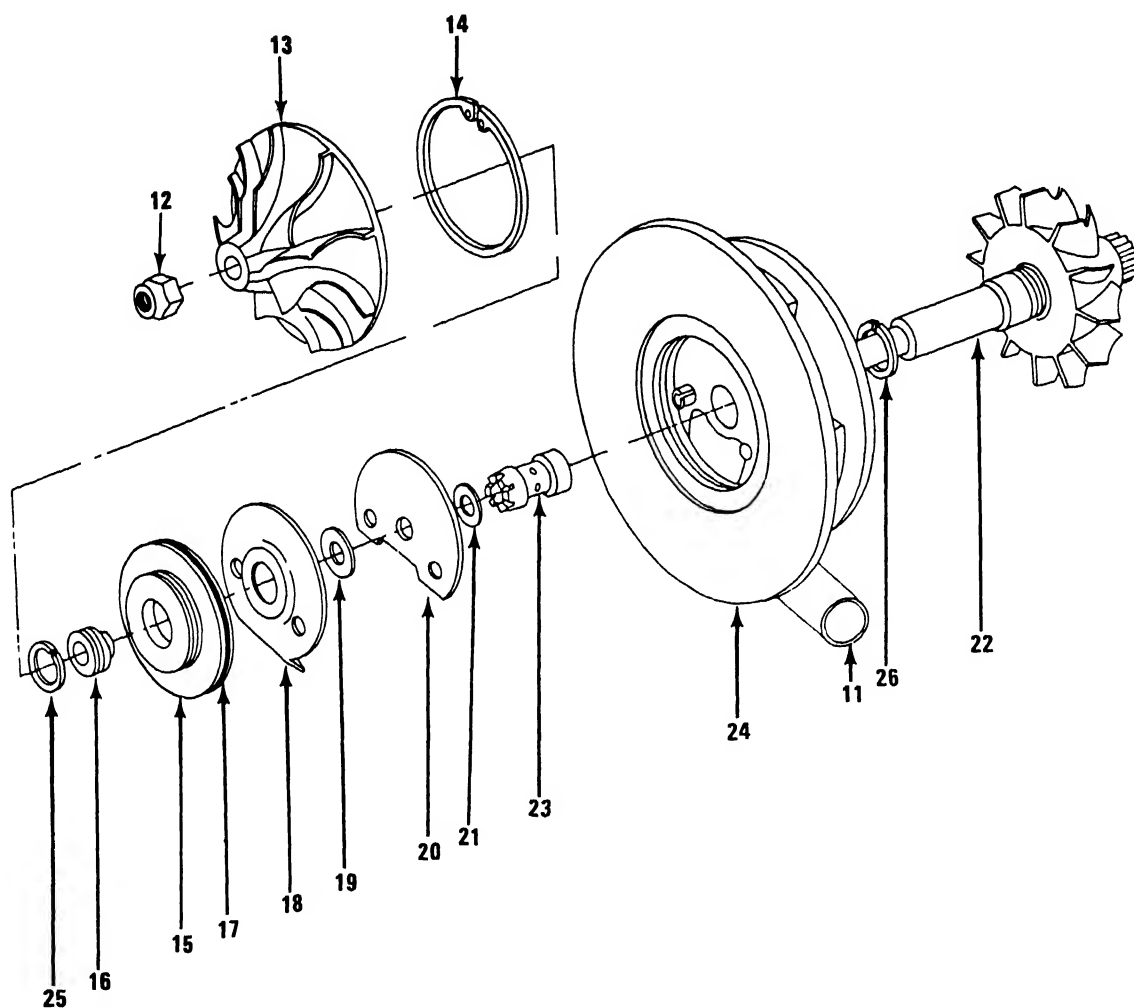
TURBOCHARGER REPAIR INSTRUCTIONS
(Continued)



TURBOCHARGER REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>DISASSEMBLE</u>			
1. Turbocharger (1)	a. Turbocharger (1)	Clamp in vise on turbine inlet flange (27).	
	b. Compressor housing (2), core assembly (3), turbine housing (4)	Scribe (mark) for correct alinement on reassembly	
	c. 8 capscrews (5), 8 washers (6), 8 lock-washers (7) and compressor housing (2)	Remove.	Use 7/16 in socket with ratchet
	d. V clamp (8) and core assembly (3)	Loosen lock nut (9) and remove	Use 7/16 in open end wrench
	e. Oil drain tube (10) and nut (11)	Remove	Use 1-1/4 in box wrench
2. Center core assembly (3)	a. Nut (12) and compressor wheel (13)	Remove	Use 1/2 in box wrench
	b. Snap ring (14)	Remove	Use snap ring pliers
	c. Insert (15)	Remove	Use two screw-drivers as levers

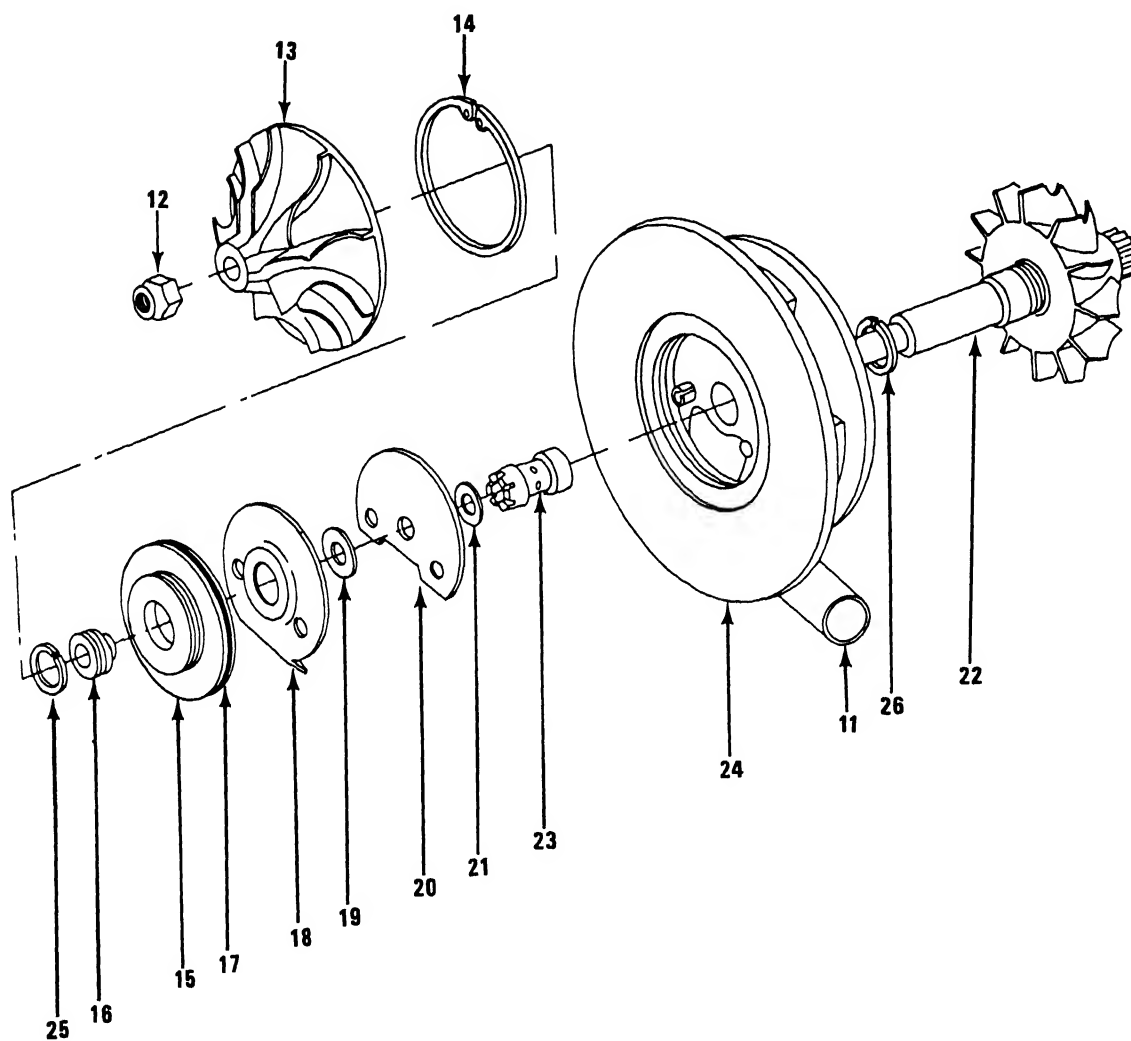
TURBOCHARGER REPAIR INSTRUCTIONS
(Continued)



TURBOCHARGER REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
3. Insert (15)	a. Spacer sleeve (16)	Push out through insert	
	b. O-ring (17) from insert (15)	Remove and discard.	
4. Bearing housing (24)	a. Oil deflector (18)	Remove.	
	b. Thrust ring (19)	Remove and discard.	
	c. Thrust plate (20)	Remove and discard	
	d. Thrust washer (21)	Remove and discard	
	e. Turbine wheel and shaft (22)	Remove	
	f. Bearing (23)	Remove and discard	
5. Spacer sleeve (16)	Piston ring (25)	Remove and discard	
6. Turbine wheel and shaft (22)	Piston ring (26)	Remove and discard	
<u>CLEAN</u>			
7	a. All components	Soak in solvent	

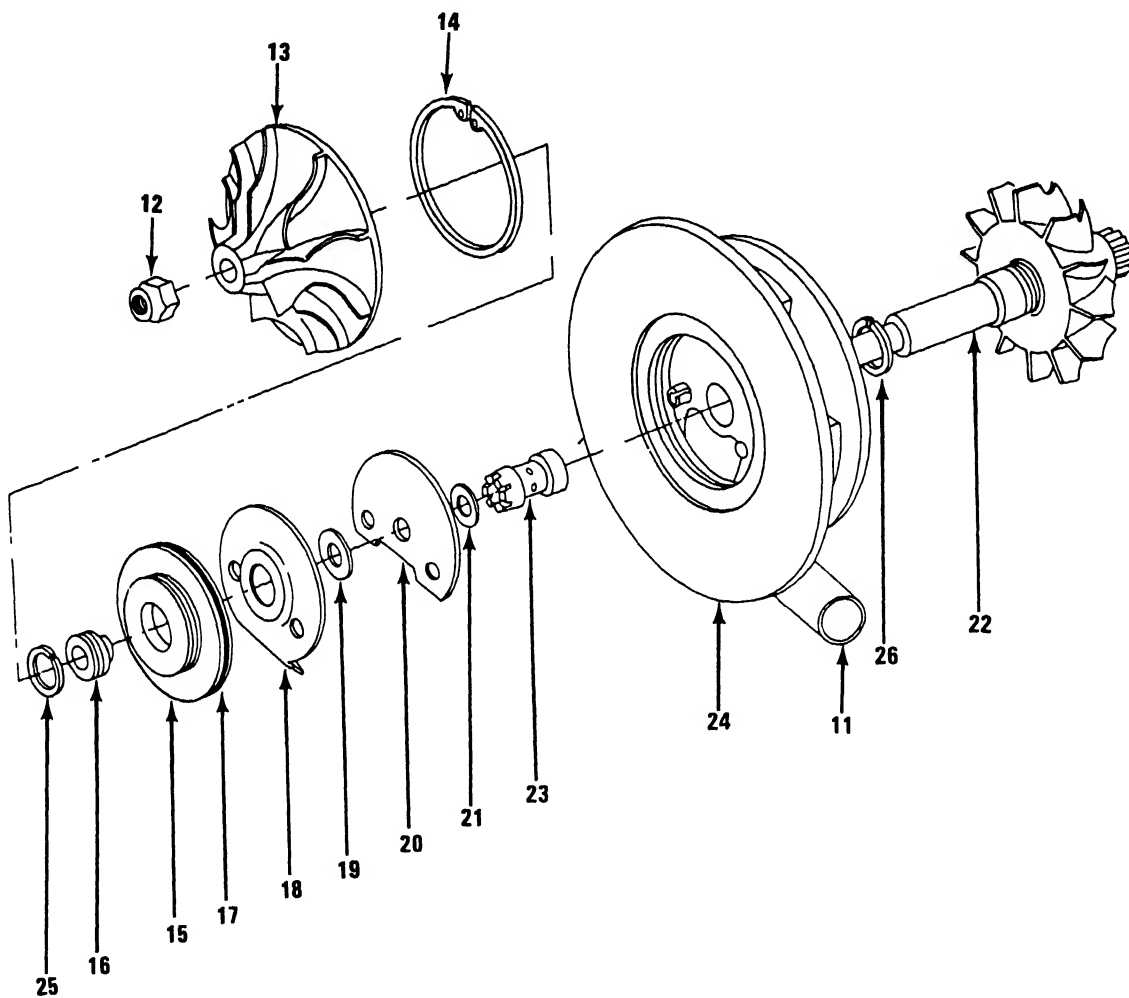
TURBOCHARGER REPAIR INSTRUCTIONS
(Continued)



TURBOCHARGER REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<p><u>CAUTION</u></p> <p>DO NOT ATTEMPT TO STRAIGHTEN BLADES.</p>			
	b. Turbine blades	<p>a. Inspect for Cracks, Bends, Chipped blades.</p> <p>b. Replace if any of above defects noted.</p>	
9. Bearing housing (24)	Bearing and piston ring bores	<p>a. Inspect for Scratches, Wear.</p> <p>b. Replace housing if unable to polish out with crocus cloth</p>	Use crocus cloth
10. Spacer sleeve (16)	Spacer and piston ring groove	<p>a. Inspect for Cracks or Knicks</p> <p>b. Replace if cracked or knicked.</p>	
11. Compressor wheel (13)	Blades	<p>a. Inspect for Cracks, Bends, Chips.</p> <p>b. Replace if defect noted.</p>	

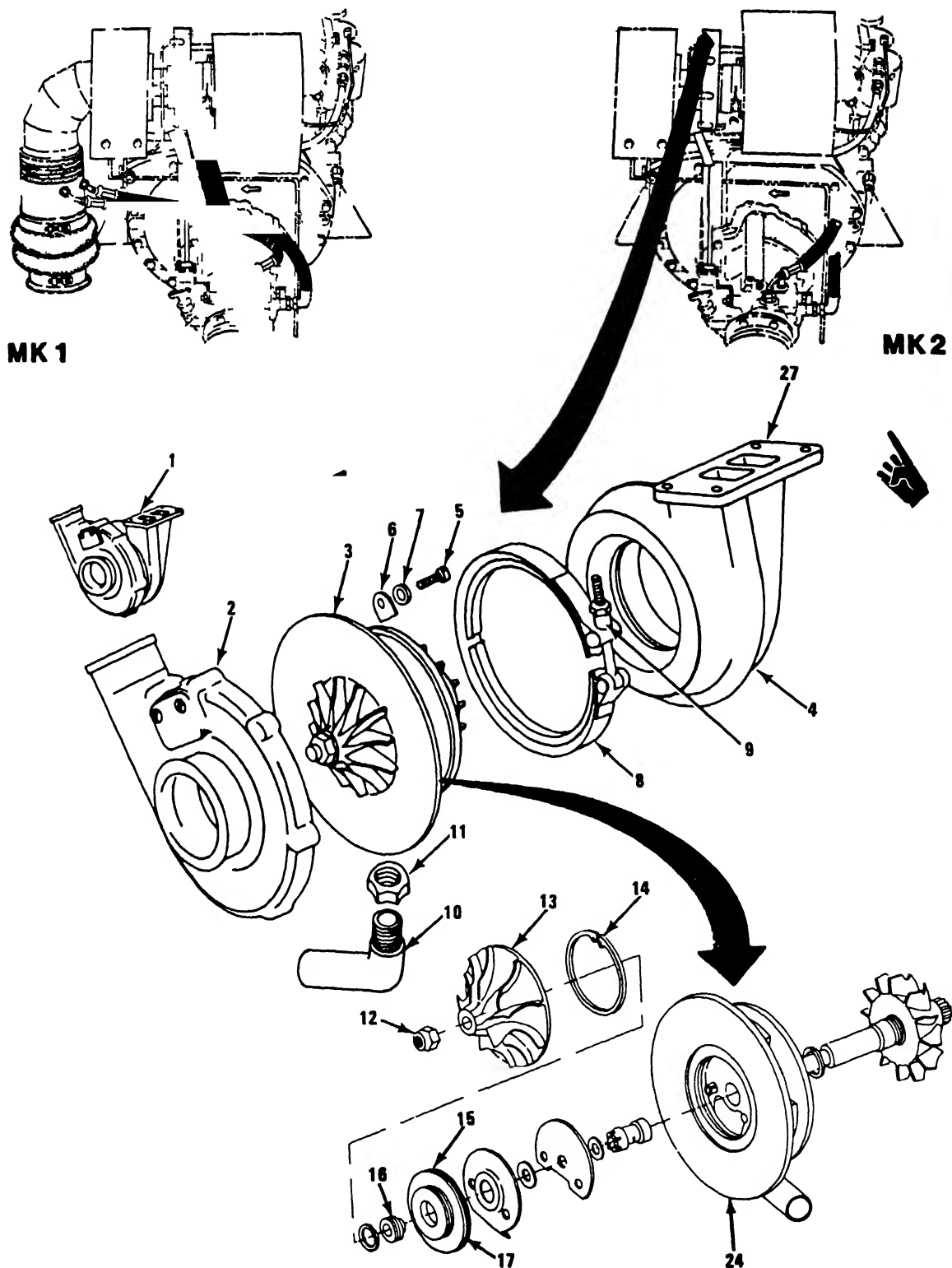
TURBOCHARGER REPAIR INSTRUCTIONS
(Continued)



TURBOCHARGER REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>ASSEMBLE</u>			
Before assembly lubricate all parts with light coat of oil.			
12. Turbine wheel and shaft (22)	Piston ring (26)	Fit on shaft.	
13. Spacer sleeve (16)	Piston ring (25)	Fit on sleeve.	
14. Bearing housing (24)	a. Bearing (23)	Insert in housing.	
	b. Turbine wheel and shaft (22)	Assemble to housing.	Do not force piston ring into housing.
	c. Thrust washer (21)	Install.	
	d. Thrust plate (20)	Install	Make sure holes in plate locate over spring pin (26) in housing.
	e. Thrust ring (19)	Install.	
	f. Oil deflector (18)	Install.	Make sure holes locate over spring pin (26) in housing with crank in plate toward oil gallery.

TURBOCHARGER REPAIR INSTRUCTIONS
(Continued)



TURBOCHARGER REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
15 Insert (15)	a O-ring (17)	Fit on insert.	
	b Spacer sleeve (16)	Push into insert from housing side	
16. Bearing housing (24)	Insert (15)	Insert into housing	Do not disturb O-ring (17)
17 Turbine wheel and shaft (22)	a Snap ring (14)	Install	Use snap ring pliers
	b Compressor wheel (13)	Mount on shaft, secure with nut (12)	Use 1/2 box wrench
18 Center core assembly (3)	Oil drain tube (10) and nut (11)	Install	Use 1-1/4 box wrench
19 Turbine housing (4)	a Inlet flange (27)	Clean gasket face	Use wire brush or putty knife
	b V clamp (8)	Aline with housing using scribe marks	
	c Center core assembly (3)	Aline with housing using scribe marks	
	d V clamp (8)	Tighten lock nut (9) to secure core to housing	Use 7/16 open end wrench
20 Center core assembly (3)	a Compressor housing (2)	Aline scribe marks	

TURBOCHARGER REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	b. 8 capscrews (5), 8 washers (6) and 8 new lock-washers (7)	Install and tighten.	Use 7/16 in socket and ratchet.
	c Spin turbine shaft	Check for free rotation.	NOTE When cold, large free play can be expected but it is normal.

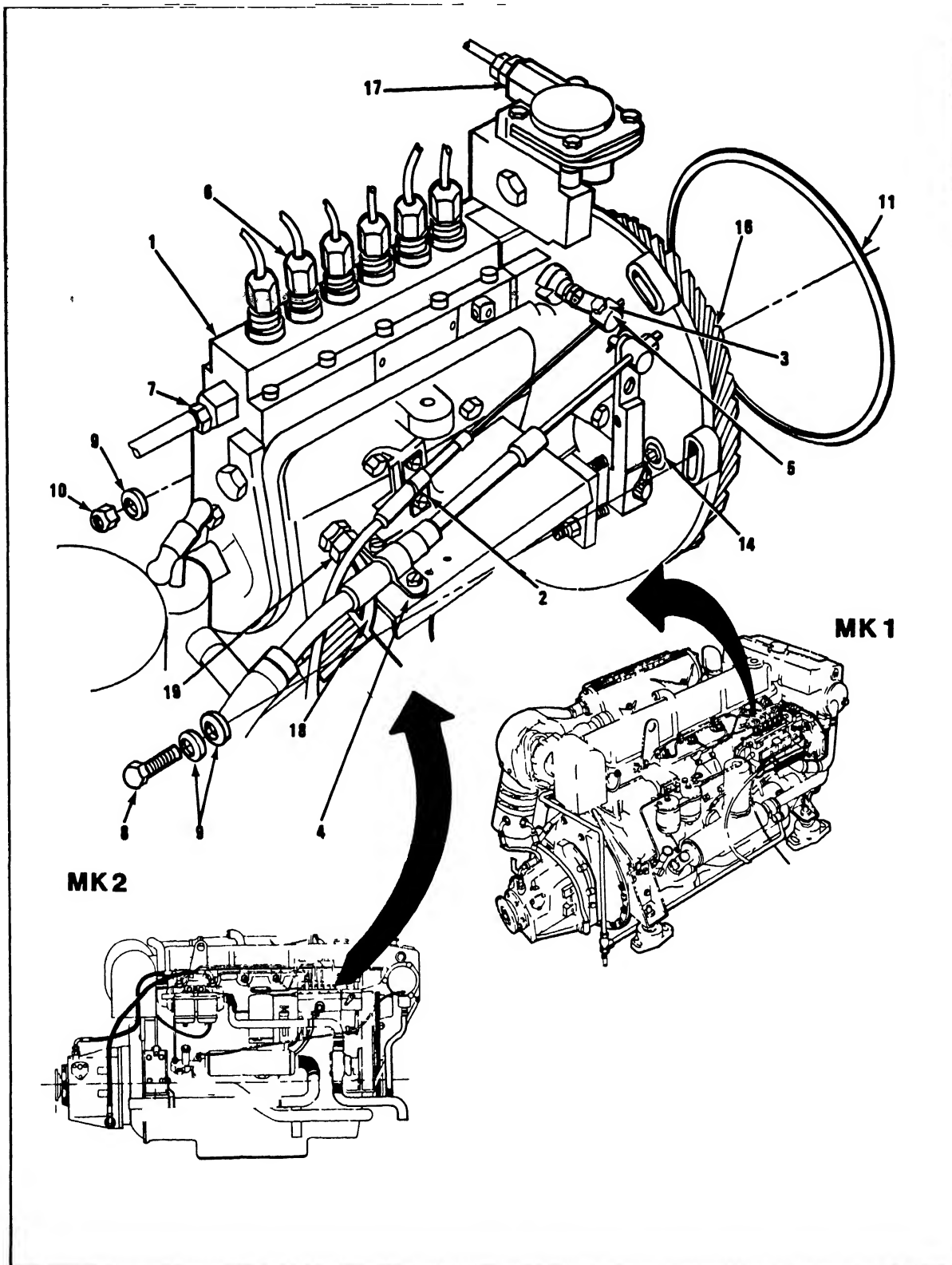
INJECTION PUMP REPLACEMENT INSTRUCTIONS**This task covers**

- a. Removal
- b. Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
3/4 in open end wrench 5/8 in box/open wrench 1/2 in box/open wrench 9/16 in socket Ratchet 6 in extension 3/8 in hex key wrench (Allen) Flat tip screwdriver, 6 inch 15/16 in socket Inspection mirror Hinge handle Long nose pliers 11/32 in box/open wrench 1/8 in drill bit Flashlight	TM 5-1940-277-20	Engine hatch covers raised.
Materials/Parts		
Injection pump O-ring Engine oil		
Personnel Required Two		

INJECTION PUMP REPLACEMENT INSTRUCTIONS
(Continued)

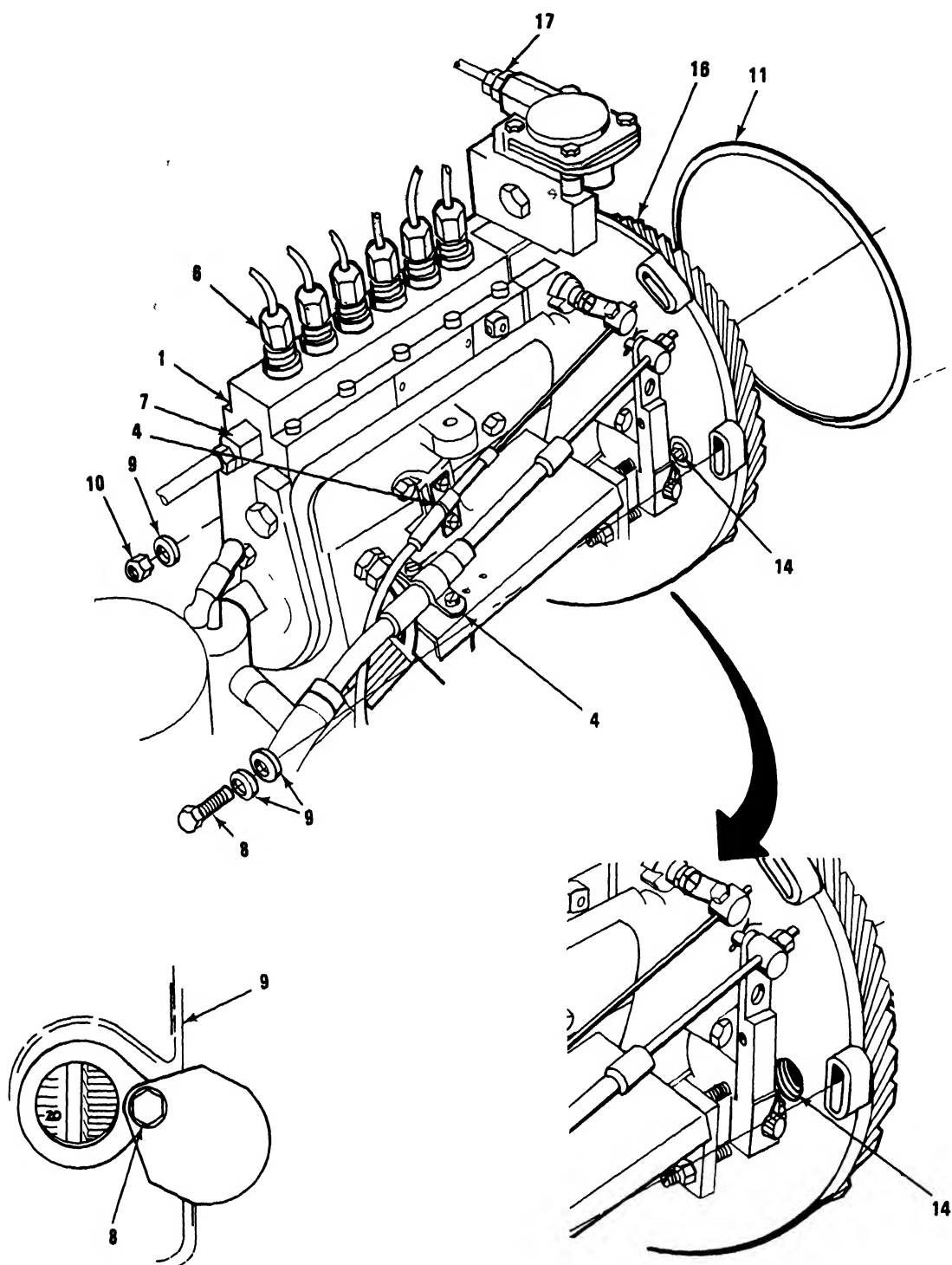


INJECTION PUMP REPLACEMENT INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1	Injection pump (1)	a Stop control cable clamp (2)	Remove two screws and clamp. Use screwdriver
		b. Stop control cable holding screw (3)	Loosen screw and pull stop control cable free Use 11/32 in wrench.
		c. Throttle cable retaining clamp (4)	Remove two screws and bracket. Use screwdriver
		d Throttle cable cotter pin (5)	Pull out pin and move cable aside Use long nose pliers
		e 6 injector pipe union nuts (6)	Unscrew Use 5/8 in open end wrench
		f Fuel line union nut (7)	Unscrew one nut at injection pump end and one nut at fuel filter end of line Use 1/2 in open end wrench Remove line
		g Governor vacuum line nut (17)	Unscrew one nut at governor and loosen one nut on intake manifold end Use 1/2 in open end wrench
		h Oil line (18)	Loosen nut (19) and disconnect oil line(18) Use 3/4 in wrench

INJECTION PUMP REPLACEMENT INSTRUCTIONS (Continued)



INJECTION PUMP REPLACEMENT INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
	i. 4 mounting bolts (8), 5 washers (9) and nut (10)	Remove bolts and washers and one nut and washer.	Use 9/16 in socket, ratchet and 6 in extension
	j. Injection pump (1)	Remove.	Work pump out of housing and free of injector lines while moving lines as little as possible
	k. O-ring (11)	Remove and discard	

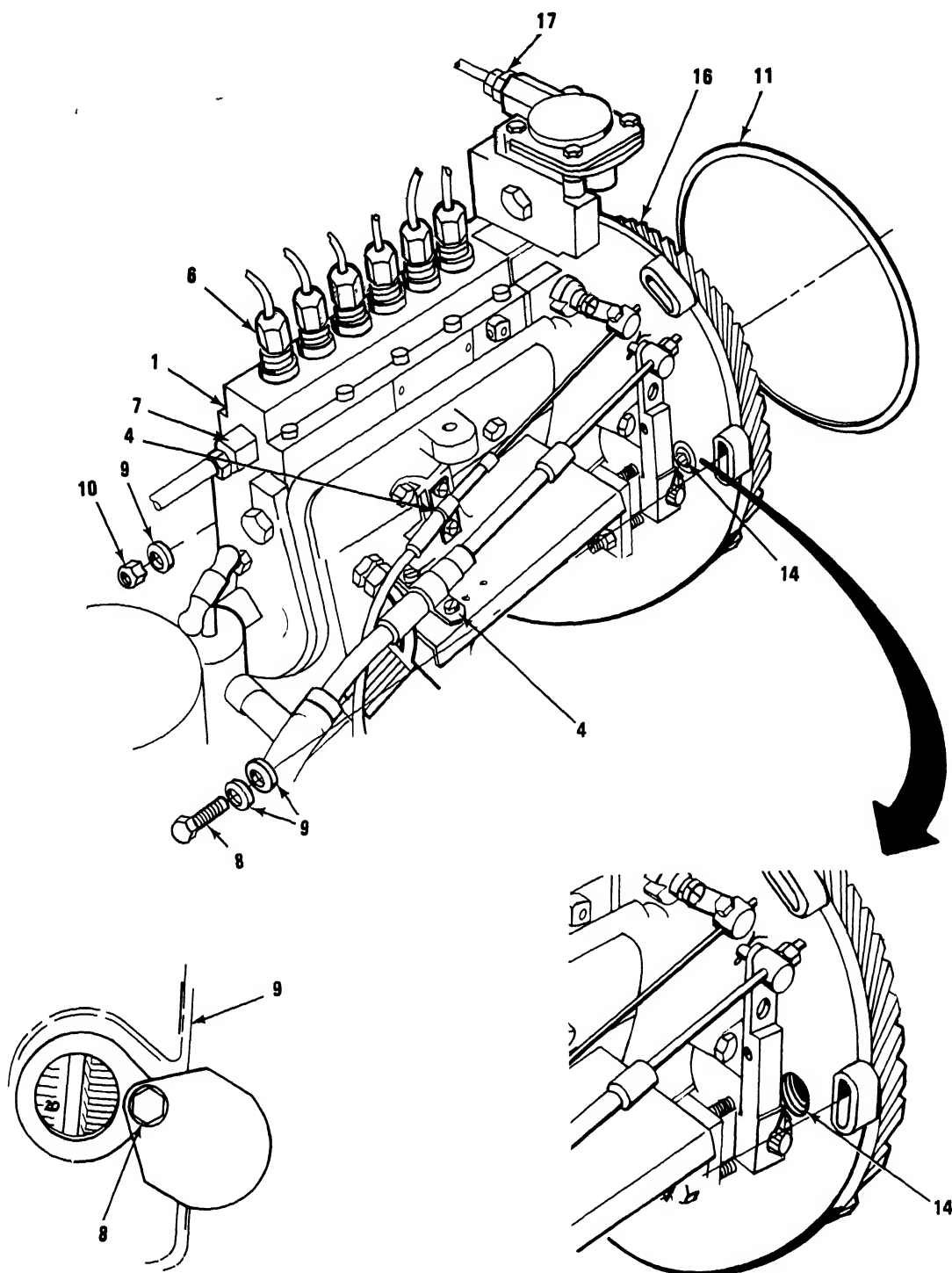
INSTALLATION

NOTE

Before pump installation the engine cylinders must be properly positioned. This is done through coordinated positioning of two marks. One on the flywheel diameter and the other on the back face of the camshaft gear as seen through the opening where the pump was removed. To view the flywheel mark you must open a viewing port located on the starboard lower quarter of the flywheel housing edge (Below rear starboard engine mount bracket)

2	Flywheel housing (12)	Viewing port nut (13)	Loosen and swing port cover open	Use 1/2 in wrench
---	-----------------------	-----------------------	----------------------------------	-------------------

INJECTION PUMP REPLACEMENT INSTRUCTIONS
(Continued)

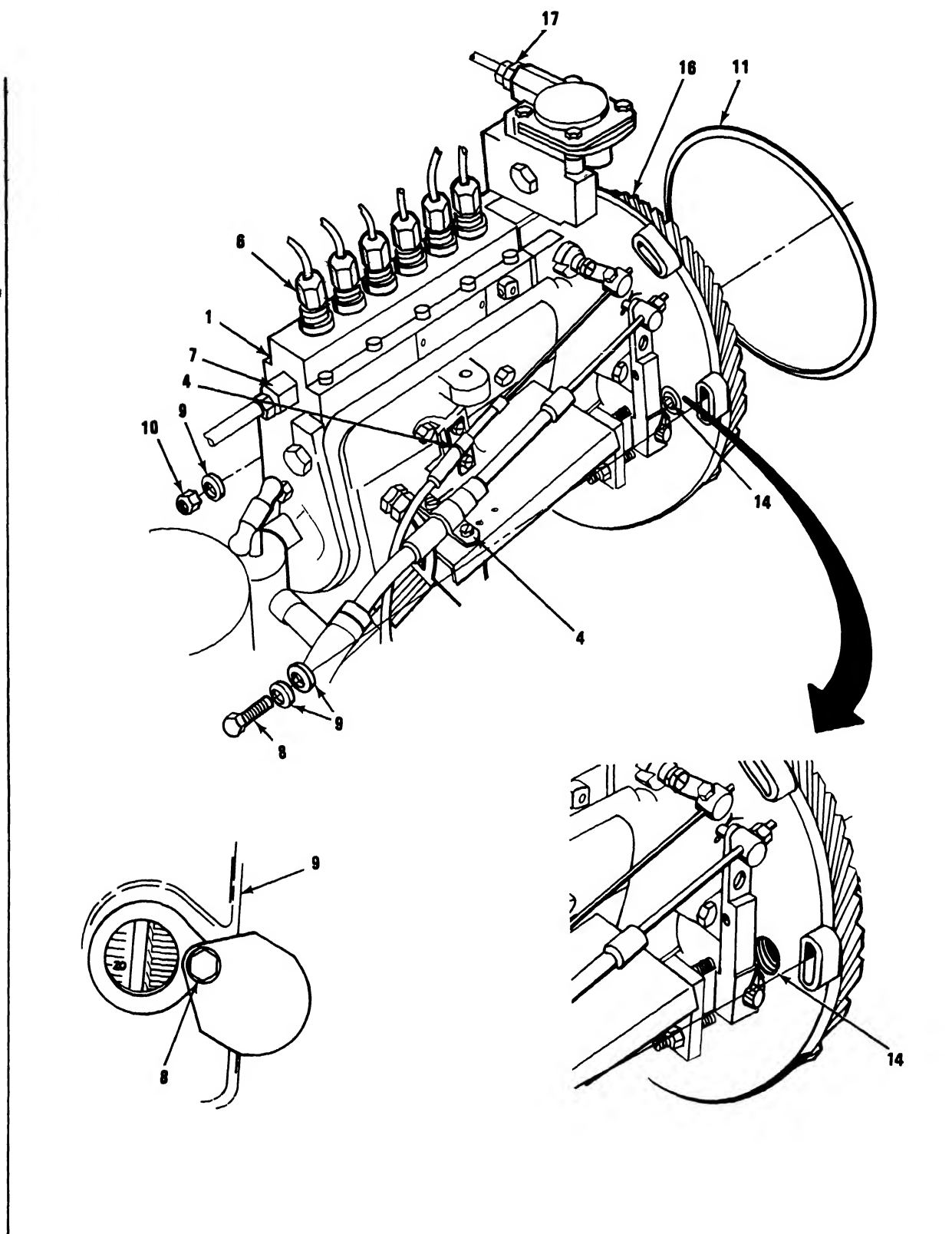


INJECTION PUMP REPLACEMENT INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
3 Flywheel and camshaft gear rear face	21 degree mark on flywheel and straight mark on camshaft gear rear face	Line 21 degree mark up with timing mark that appears on edge of viewing port opposite the securing bolt. At the same time this is lined up, the mark on the rear face of the camshaft gear must be visible. Rotate engine until both conditions are satisfied	One person will use 15/16 in socket and hinge handle on nut for crankshaft pulley at the front of engine to rotate engine. At the same time a second person using an inspection mirror must observe the flywheel port to line up the 21 degree mark on the flywheel and the pointer on the flywheel housing and check the rear face of the camshaft gear to see that the mark is visible in the opening left by removal of the injection pump. BOTH CONDITIONS MUST BE SATISFIED. This puts engine piston in proper position relative to injection pump positioning.
4 Injection pump (1)	a Timing hole plug (14)	Unscrew from pump mounting flange	Use 3/8 in hex key wrench (Allen)

INJECTION PUMP REPLACEMENT INSTRUCTIONS
(Continued)

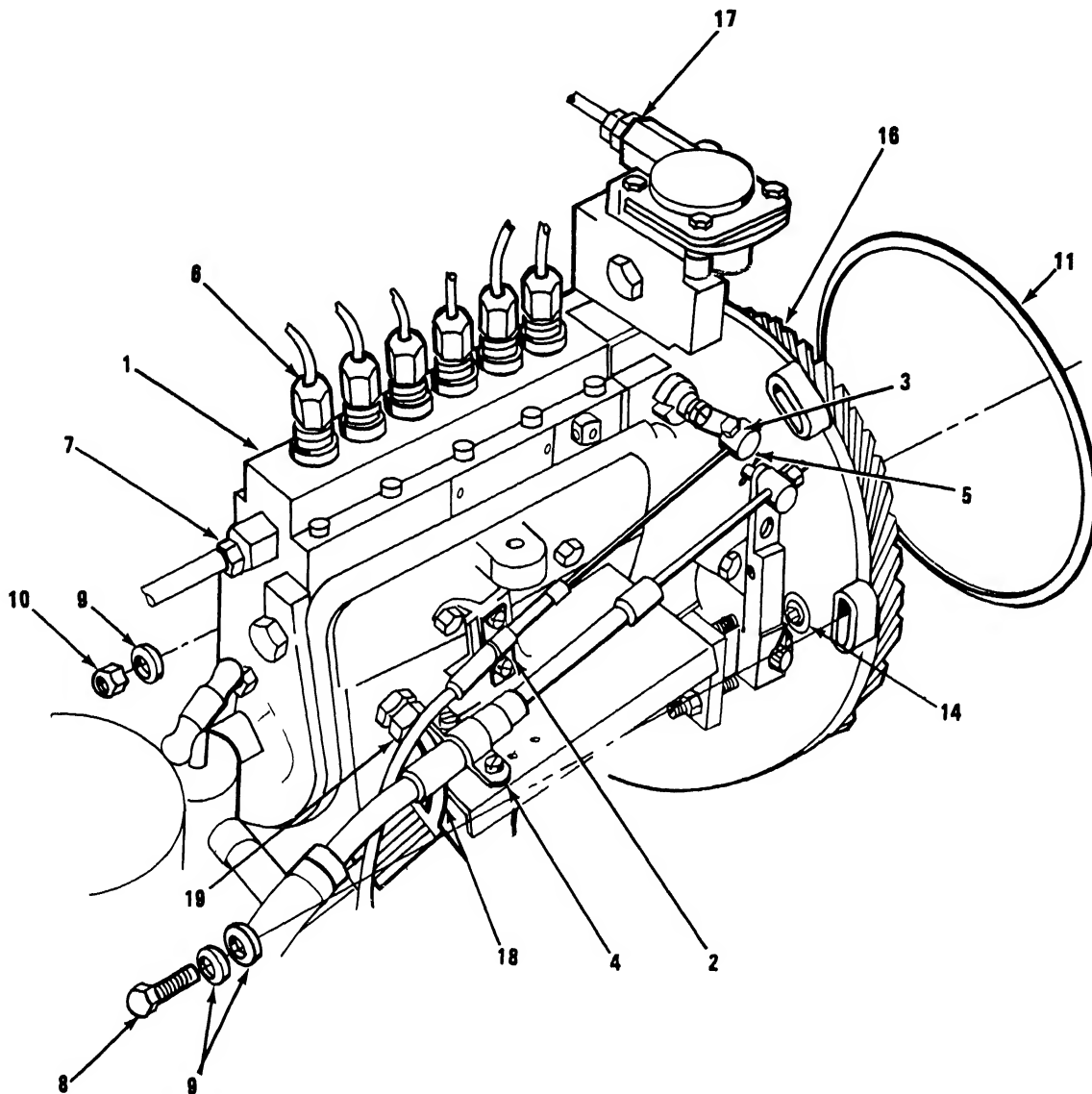


INJECTION PUMP REPLACEMENT INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
5 Engine	b. Gear (16)	Turn until small indent mark in rear face of gear is visible through hole	Use flashlight to see indent
	c. Gear (16)	Fit 1/8 in drill bit through timing hole and seat in indent Move gear until drill bit is centered in hole Remove bit when centered	Use 1/8 in drill bit
	d O-ring (11)	Lightly coat with clean engine oil and position on shoulder on front face of pump mounting flange	
	a Injection pump (1)	Fit pump to engine keeping the stud in center of slot- ted mounting hole as much as possible	Pump may have to be rotated slightly to engage pump teeth to gear teeth

INJECTION PUMP REPLACEMENT INSTRUCTIONS
(Continued)

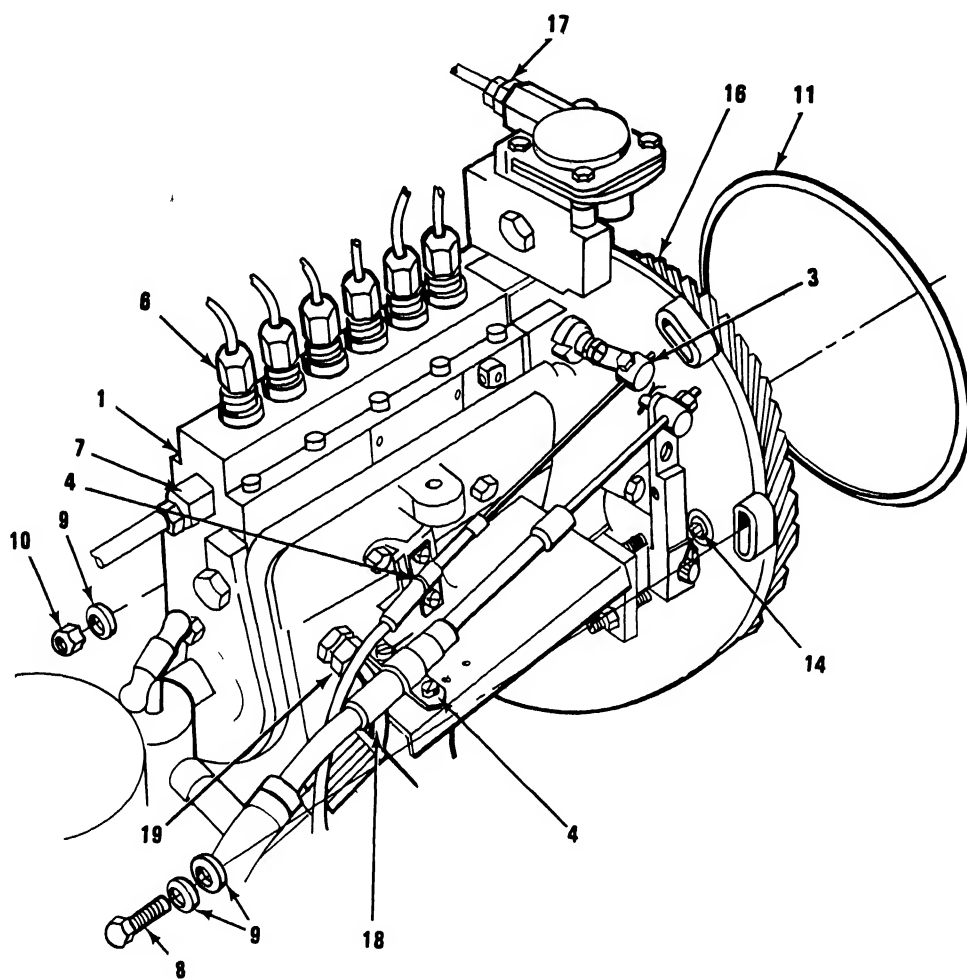


INJECTION PUMP REPLACEMENT INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
6. Injection pump (1)	a. 5 mounting washers (9), 4 bolts (8) and nut (10)	Install washers and bolts and one washer and nut to protruding stud	Use 9/16 in socket, ratchet and 6 in extension
	b. Timing hole plug (14)	Screw into hole in pump flange and tighten	Use 3/8 in hex key wrench (Allen)
	c. 6 injector pipe union nuts (6)	Position and tighten	Use 5/8 in open end wrench
	d. Governor vacuum line nut ()	Connect nut to governor and tighten at governor and at intake manifold	Use 1/2 in wrench
NOTE			
Prior to connecting oil line, fill injector pump at oil line opening with 1/3 pint of engine oil			
	e. Oil Line (18)	Connect nut (19) to injector pump and tighten	Use 3/4 in wrench
	f. Throttle cable cotter pin (5)	Connect cable to throttle lever and install cotter pin	Connect cable to middle hole in lever.
	g. Throttle cable retaining clamp (4)	Position clamp and secure with two screws	Use screwdriver

INJECTION PUMP REPLACEMENT INSTRUCTIONS
(Continued)



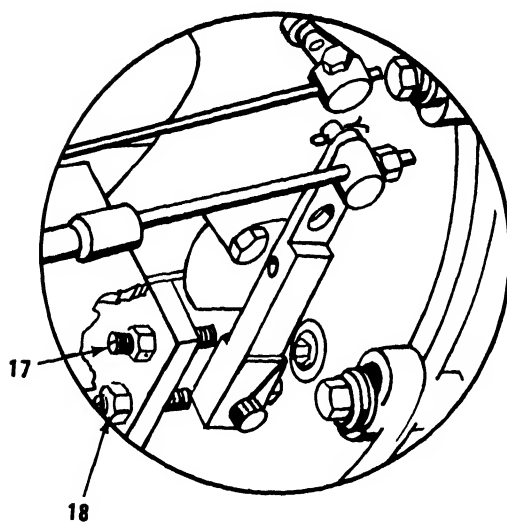
INJECTION PUMP REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	h. Stop control cable holding screw (3)	Run end of stop cable through inner hole in stop lever and tighten securing screw	Use 11/32 in wrench Make sure stop control on dashboard pushed in and stop lever on pump is all the way forward before tightening screw
	i. Stop control cable clamp (2)	Position and secure with two screws	Use screwdriver
	j Fuel line union nut (7)	Install fuel line between pump and fuel filters Connect and tighten union nut at pump end of line and at fuel filter end	Use 1/2 in open end wrench If line does not appear to position properly when attempting installation check to see if it fits better by turning it around

NOTE

Boat must be in water Do fuel system bleed procedure per TM 5-1940-277-20 Start engine and check for leaks Tighten any leaking connections Proceed to next step with engine still running at idle speed

INJECTION PUMP REPLACEMENT INSTRUCTIONS
(Continued)



INJECTION PUMP REPLACEMENT INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
	j Idle speed adjusting screw (17)	Loosen lock nut and back screw off Set operators throttle control so engine is idling at 650 rpm. Run screw up to contact with speed selector lever, hold and tighten lock nut	Screw located on engine side of pump. Use 1/2 in wrench and screwdriver.
	k Maximum speed adjusting screw (18)	Loosen lock nut and back screw off Adjust operator throttle control for 2800 rpm Run screw up against speed selector lever, hold and tighten lock nut	Screw located immediately below idle adjusting screw. Use 1/2 in wrench and screwdriver.

NOTE

Bring engine speed to idle for one minute and stop engine



INJECTOR TEST AND REPAIR INSTRUCTIONS

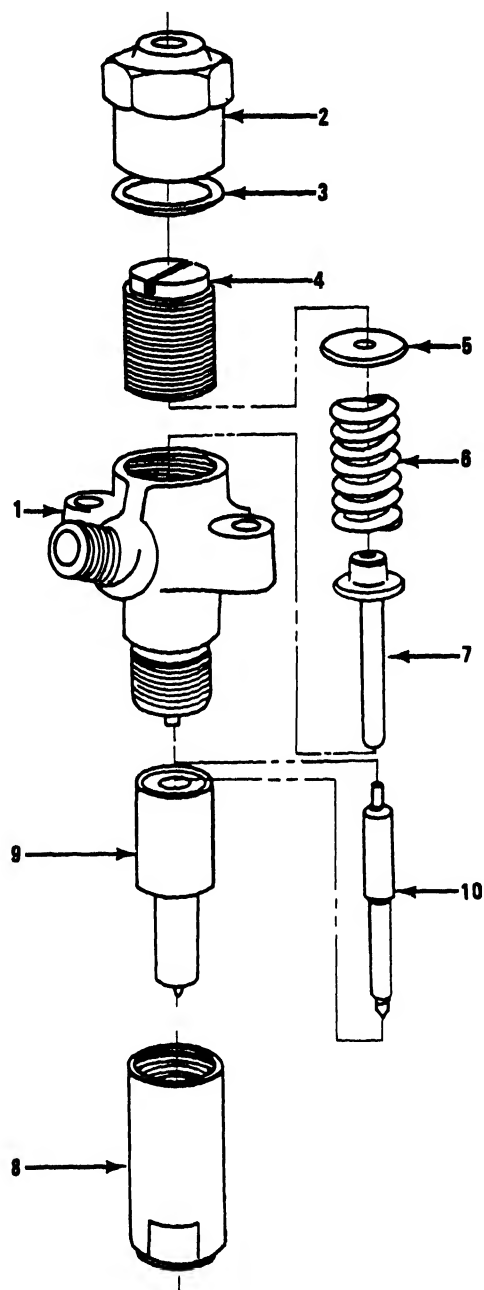
This task covers

- | | | | | | |
|---|-------------|---|------------|---|----------|
| a | Testing | c | Inspection | e | Repair |
| b | Disassembly | d | Cleaning | f | Assembly |

INITIAL SETUP

Tools	Equipment Condition	Condition Description
1 in box/open wrench	TM 5-1940-277-20	Injector removed from engine
3/4 in box/open wrench		
Torque wrench		
Flat tip screwdriver		
1 in socket		
Soft brass wire brush		
Special Tools		
Nozzle nut socket		
Injector tester		
Materials/Parts		
Copper washer		
Diesel fuel		

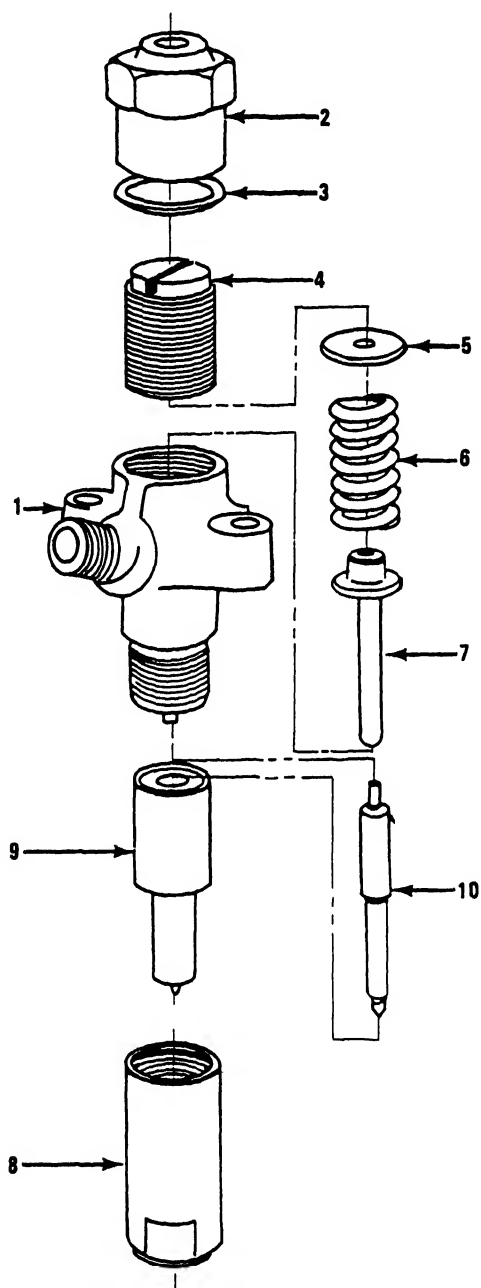
INJECTOR TEST AND REPAIR INSTRUCTIONS
(Continued)



INJECTOR TEST AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>TESTING</u>			
1. Injector tester	a. Nozzle holder (1)	Connect to testing machine.	Use testing machine
	b. Injector cap nut (2)	Loosen	Use 1 in wrench
	c. Spring adjusting screw (4)	a. Pump tester up to pressure of 2,705 psig (184 1 atm)	Adjust by placing screwdriver down through leak-off drilling in cap nut (2). Open valve on tester one-half turn from closed position Pump tester as necessary to maintain constant pressure sprays.
		b. Rotate spring adjusting screw counter-clockwise until nozzle	
		c. Hold spring adjusting screw and tighten injector cap nut (2) securely	
	d Needle valve (10)	Back Leakage Test o Pump tester to 2,190 psig (149 atm) o Fully open tester valve.	

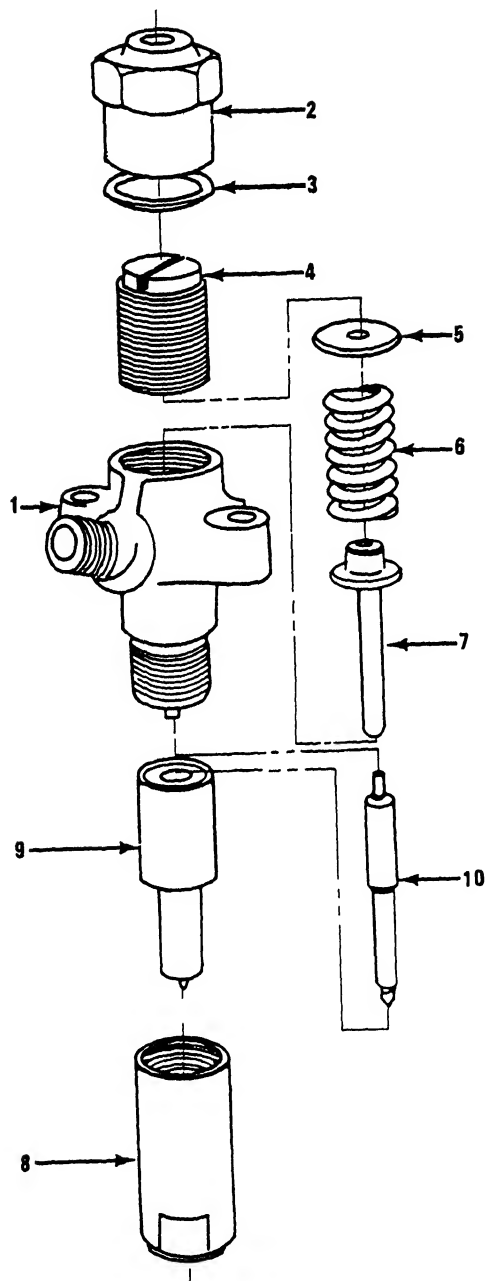
INJECTOR TEST AND REPAIR INSTRUCTIONS (Continued)



INJECTOR TEST AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		<ul style="list-style-type: none"> Check time it takes to fall to 1,455 psig (99 atm) The time should be 10 seconds for new injectors, 6 seconds for reconditioned 	Less time indicates damaged or dirty injector. Disassemble, inspect and repair
	e Needle valve (10)	Seat Leakage Test <ul style="list-style-type: none"> Wipe injector tip dry Pump tester to 2,962 psig (201.6 atm) Hold pressure 10 seconds Repair if test failed 	Nozzle tip dampness is permissible but drop must not be visible
	f Injector	Atomization Test <ul style="list-style-type: none"> Close valve on tester Pump tester until pressure between 2,962 and 3,036 psig (202 and 207 atm) is reached Examine four sprays 	Maintain pressure Each spray should have no visible streaks or distortion Spray should spread about 2 inches before hitting sides of containers Injector should break with hard note (pop)

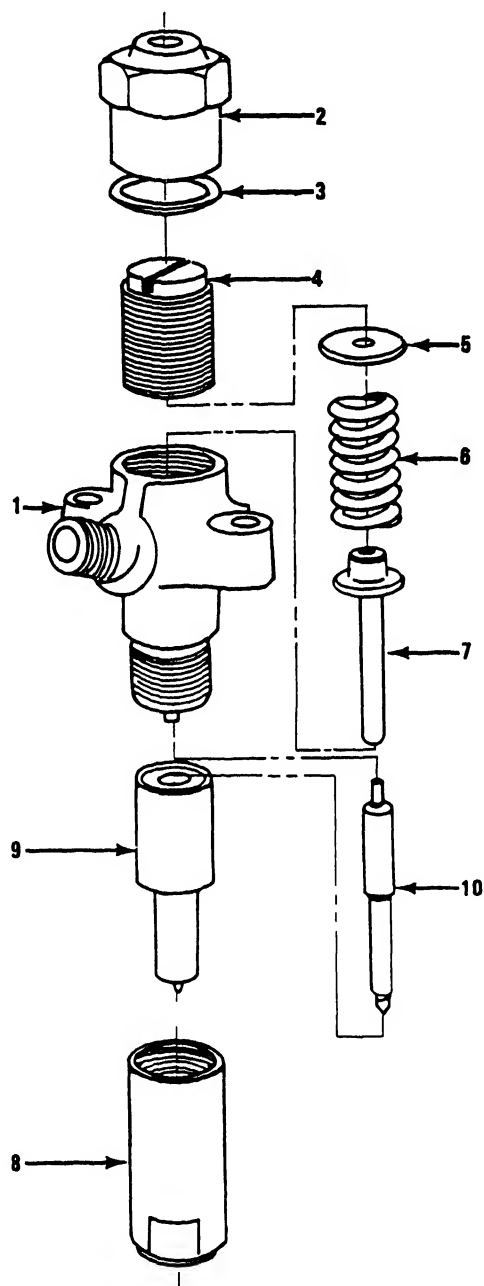
INJECTOR TEST AND REPAIR INSTRUCTIONS
(Continued)



INJECTOR TEST AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS	
NOTE				
If all tests are satisfied, no further action is required Injector is ready for use				
NOTE				
Do not handle injector parts with dry fingers Always moisten fingers with clean diesel fuel before handling parts				
<u>DISASSEMBLY</u>				
2	Nozzle holder (1)	a Injector cap nut (2)	Remove	Use 1 in wrench Injector must be held securely
		b Copper washer (3)	Remove and discard	
		c Spring adjusting screw (4)	Unscrew and remove	Use screwdriver
		d Spring seat (5)	Remove	
		e Spring (6)	Remove	
		f Spindle (7)	Remove	

INJECTOR TEST AND REPAIR INSTRUCTIONS
(Continued)



INJECTOR TEST AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	g Nozzle nut (8)	Unscrew and remove	Use 3/4 in wrench Do not turn injector upside down to perform this step The nozzle assembly and needle valve come off with nozzle nut
	h Nozzle assembly (9)	Lift out of nozzle nut	Nozzle and needle valve are lapped and must be kept as a pair

NOTE

Do not interchange needle valves

3	Nozzle assembly (9)	Needle valve (10)	Lift out of assembly
---	---------------------	-------------------	----------------------

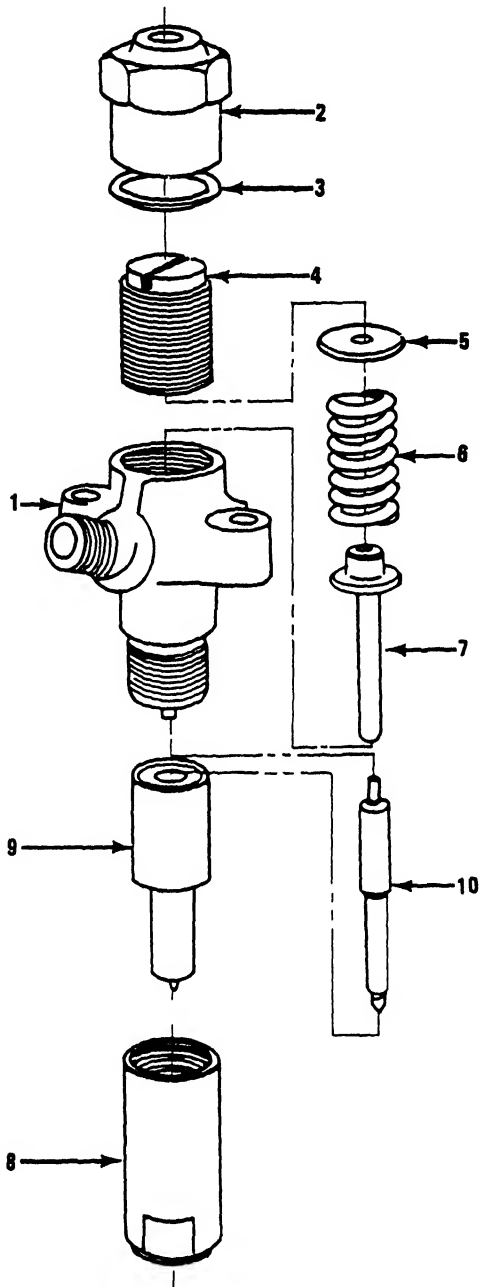
INSPECTION, CLEANING AND REPAIR

NOTE

Wash all injector parts in clean diesel fuel

4.	Nozzle assembly (9)	a Clean off all carbon with soft brass wire brush
		b Inspect needle valve tip for bluing and seat for scouring

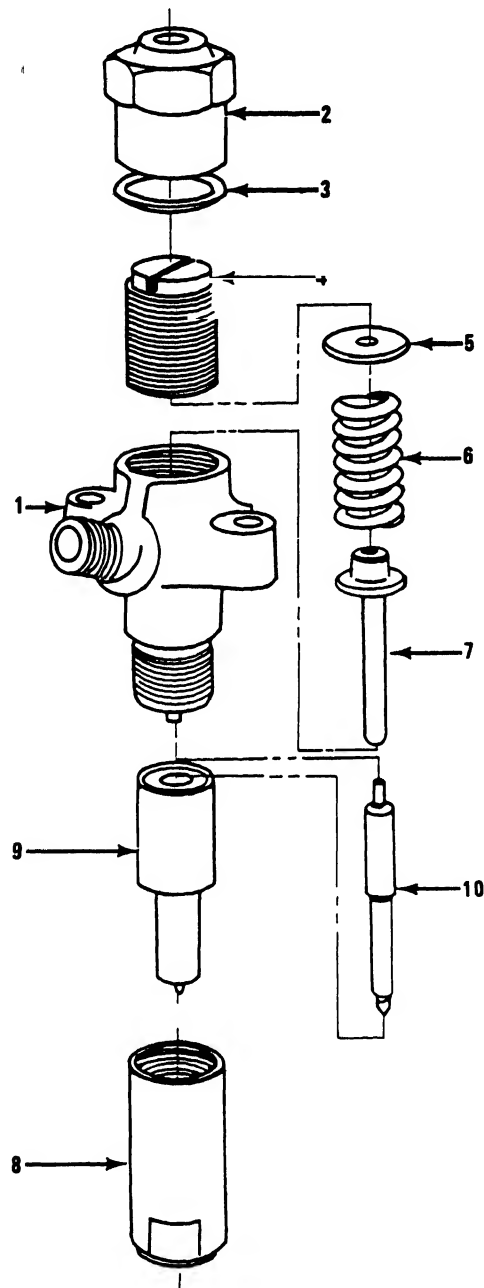
INJECTOR TEST AND REPAIR INSTRUCTIONS
(Continued)



OR REPAIR INSTRUCTIONS
(ued)

ON	ITEM	ACTION	REMARKS
		c. Replace nozzle and valve if blued or scoured.	
	Nozzle assembly (9)	a. Look at spray holes.	They should not be filled with carbon.
		b. If filled with carbon replace nozzle assembly.	
	Spring (6)	a. Check for breaks, rust and square ends.	
		b. Replace if defective.	
	Spindle (7)	a. Examine surface in bore at bottom end of spindle.	Should not be seriously flattened.
		b. Replace if damaged.	
	Nozzle holder (1) and nozzle nut (8)	a. Inspect joint faces for scratches.	
		b. Replace if scratched.	
	Nozzle assembly (9) and needle valve (10)	a. Wet all surfaces with clean diesel fuel.	

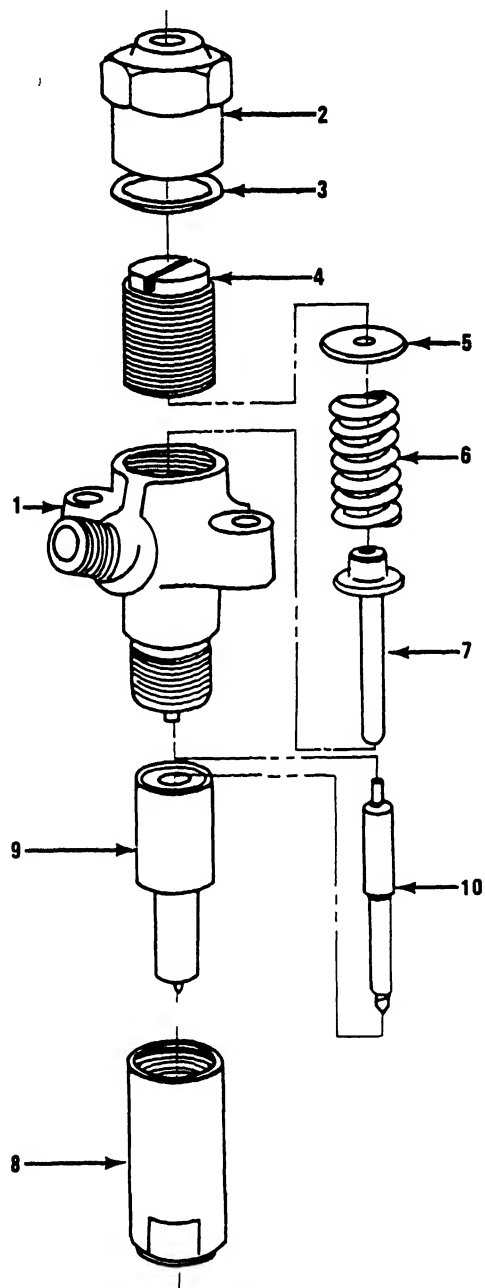
INJECTOR TEST AND REPAIR INSTRUCTIONS
(Continued)



INJECTOR TEST AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. Fit valve into nozzle.	Valve should drop in under own weight and fall out when nozzle is inverted.
		c. If valve fails test, replace both nozzle and needle valve.	
<u>ASSEMBLY</u>			
10. Nozzle assembly (9)	Needle valve (10)	Fit needle valve into assembly.	
11. Nozzle nut (8)	Nozzle assembly (9)	Fit into nut.	
12. Nozzle holder (1)	a. Nozzle nut (8) and nozzle assembly (9)	Locate carefully on dowels on holder and screw on. Torque to 45 - 50 ft-lb.	Use nozzle nut socket and torque wrench.
	b. Spindle (7)	Fit into top of holder.	
	c. Spring (6)	Fit over spindle into holder.	
	d. Spring seat (5)	Fit on top of spring.	

INJECTOR TEST AND REPAIR INSTRUCTIONS
(Continued)



INJECTOR TEST AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	e Spring adjusting screw (4)	Screw into top of holder until pressure on spring is felt	
	f Copper washer (3)	Fit over top of adjusting screw	
	g Injector cap nut (2)	Screw on spring adjusting screw Do not tighten	Make sure copper washer (3) remains positioned
13 Injector tester	a Nozzle holder (1)	Connect to tester Pump tester pressure and rotate spring adjusting screw clockwise at same time Adjust until injector opens (sprays) at 2,999 psig (205 atm)	Use screwdriver
	b Injector cap nut (2)	Torque to 37 - 43 ft-lb	Use 1 in socket and torque wrench
14 Injector tester	Nozzle holder (1)	Retest needle valve back leakage, needle seat leakage and atomization	Steps 1d, 1e, 1f If injector fails test replace injector

CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS

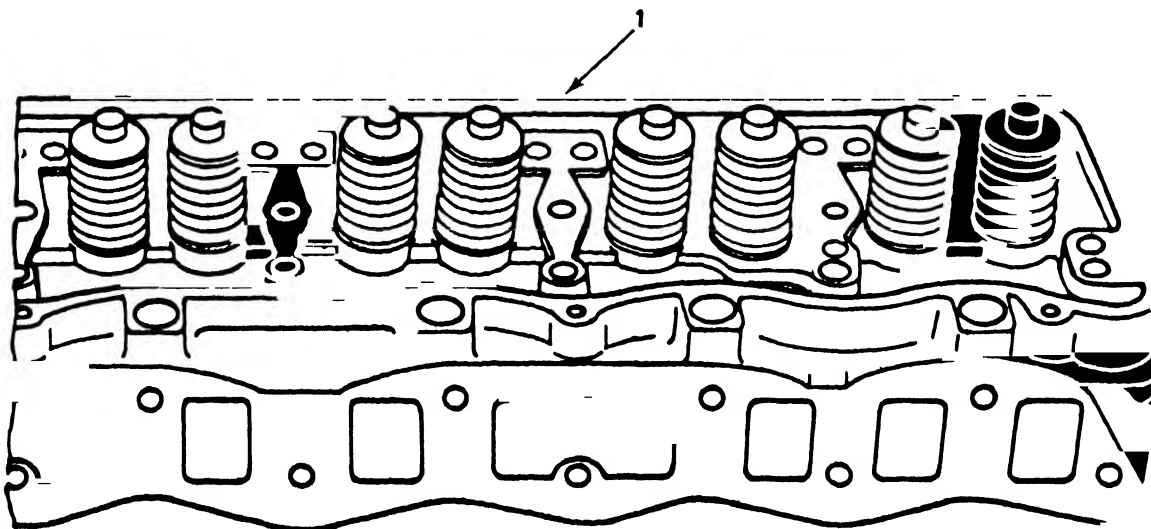
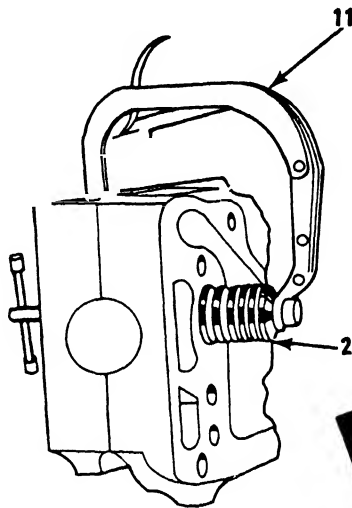
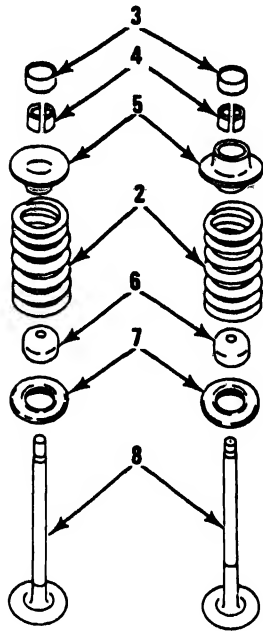
This task covers.

- a. Disassembly
- b. Inspection and Repair
- c. Assembly

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Valve spring compressor	Page 2-291	Cylinder head assembly removed.
Valve guide remover		
Hammer, ball peen		
Valve seat remover		
Micrometer caliper, inside		
Micrometer caliper, outside		
Valve seat grinding kit		
Lathe		
Spring tester		
Straightedge		
Valve guide installer		
Valve seat installer		
Air compressor		
Air blow gun		
Feeler gage		
Safety goggles		
Materials/Parts		
Oil seals, valve stem		
Engine oil		

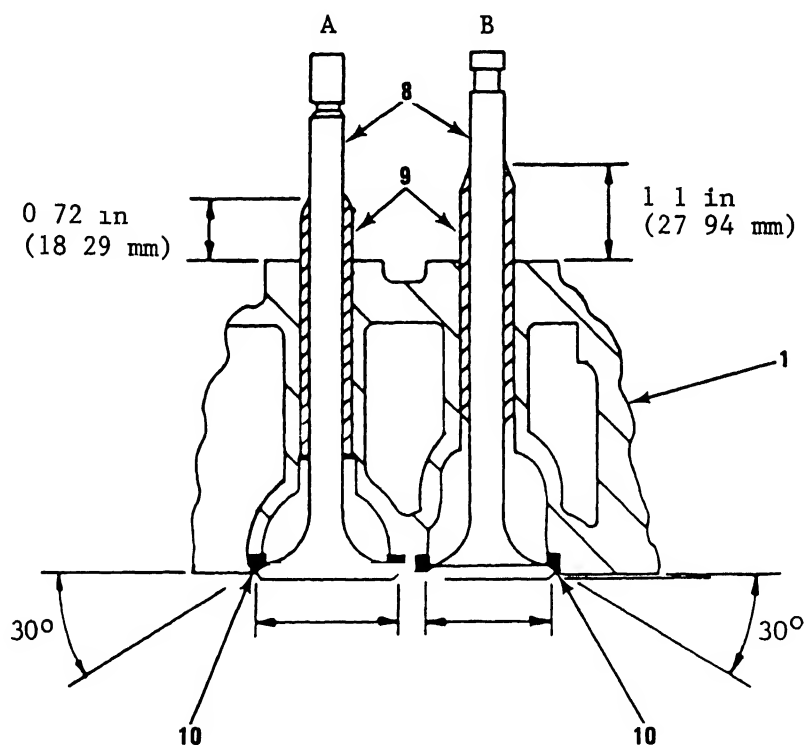
CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)



CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
NOTE			
When disassembling valves be sure to maintain component identification by valve number. Valves are numbered front to rear, one through twelve. Reused components must be reassembled to their original positions.			
<u>DISASSEMBLE</u>			
1. Cylinder head assembly (1)	a. Cylinder head (1)	Turn onto side.	
	b. Valve springs (2)	Compress.	Use valve spring compressor (11).
	c. Valve stem cap (3)	Remove.	
	d. Split collets (4)	Extract.	
	e. Valve springs (2)	Release compression.	
	f. Spring retainers (5)	Remove.	
	g. Valve springs (2)	Remove.	
	h. Oil seals (6)	Remove and discard.	
	i. Spring seats (7)	Remove	

CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)

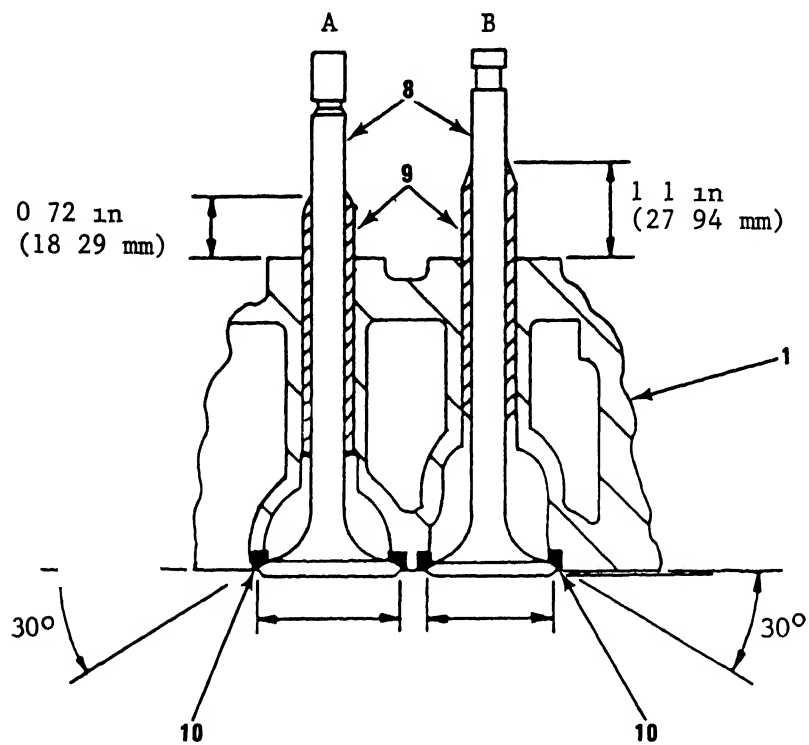


A - INLET VALVE
B - EXHAUST VALVE

CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	j. Valves (8)	Remove.	Keep valves in order.
<p style="text-align: center;">NOTE</p> <p>Inspect valve guides and seat inserts for serviceability before removing. Do not remove unless they are being replaced.</p>			
	k. Valve guides (9)	Remove.	Use valve guide remover and hammer.
	l. Valve seat inserts (10)	Remove.	Use valve seat remover and hammer.
<p><u>INSPECTION AND REPAIR</u></p>			
2. Cylinder head (1)	a. Valve guides (9)	<p>a. Measure clearance between valve stem and guide (bore diameter minus stem diameter)</p> <p>- Inlet 0.0011 to 0.0033 in. (0.025 to 0.084 mm)</p> <p>- Exhaust 0.0018 to 0.004 in. (0.046 to 0.102 mm).</p> <p>b. Measure guide (9) protrusion above cylinder head.</p>	<p>Use micrometer calipers, inside and outside.</p> <p>See figure.</p>

CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)

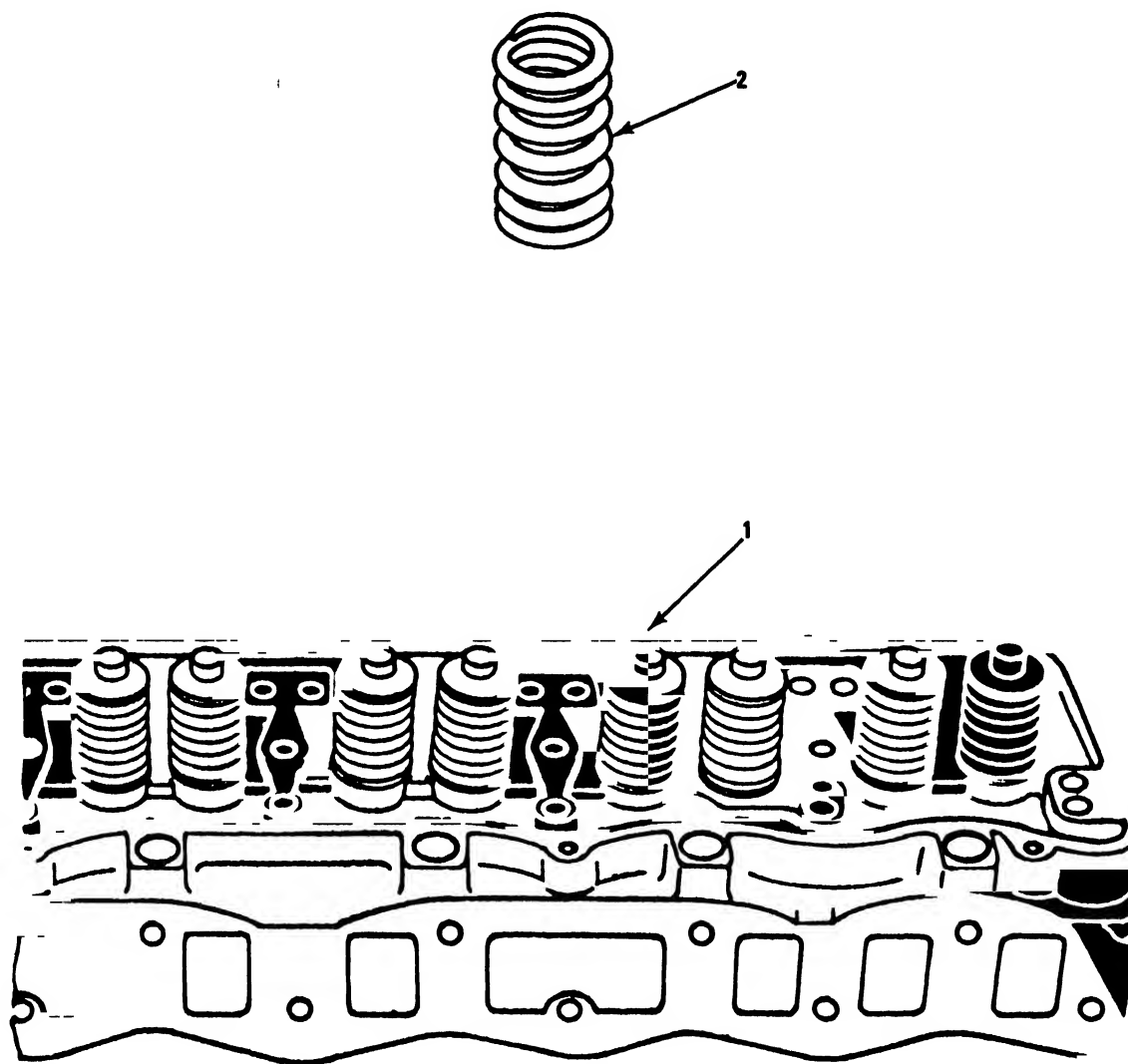


A - INLET VALVE
B - EXHAUST VALVE

CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		c. Replace guide if worn	See removal step 1k.
	b. Valve seat inserts (10)	a. Inspect for Excessive carbon build-up, Pitting, Cracks, Seat angle greater than 30° , and Looseness	
		b. Recut seats which are pitted or burned	Use valve seat grinding kit
		c. Replace defective insert	See removal step 1k
3	Valve (8)	Valve (8)	
		a. Inspect face for Pitting, Distortion (warpage), Ridging, Cracks, and Excessive carbon build-up	
		b. Inspect stem for Scuffing, Scratches	

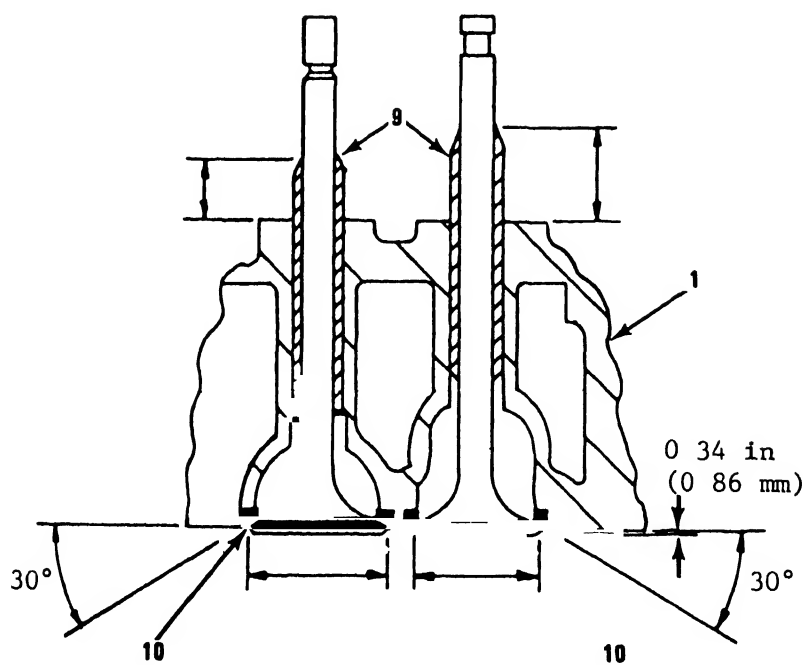
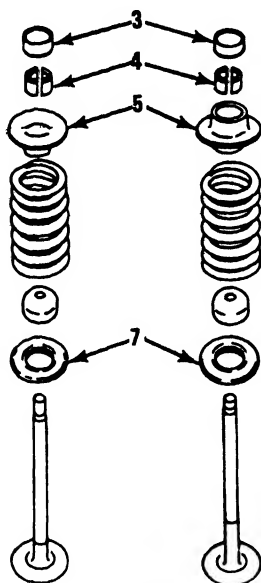
CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)



CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		c. Regrind face if not unduly pitted or distorted. Minimum edge thickness 0.008 in. (0.79 mm).	Use lathe.
		d. Replace valve guide if valve stem scuffed or scratched.	
4. Valve spring (2)	Valve spring (2)	a. Inspect for Distortion, Broken ends.	
		b. Test for resiliency. Limits Valve open - 163 lb. (73.94 kg) Valve closed - 65 lb (29.48 kg).	Use spring tester.
		c. Replace spring if defect noted or not within resiliency.	
5. Cylinder head (1)	Cylinder head (1)	a. Inspect for warpage.	Use accurate straightedge and feeler gage.
		b. Inspect for cracks.	Seal cooling passages, pressurize and place head in heated water.

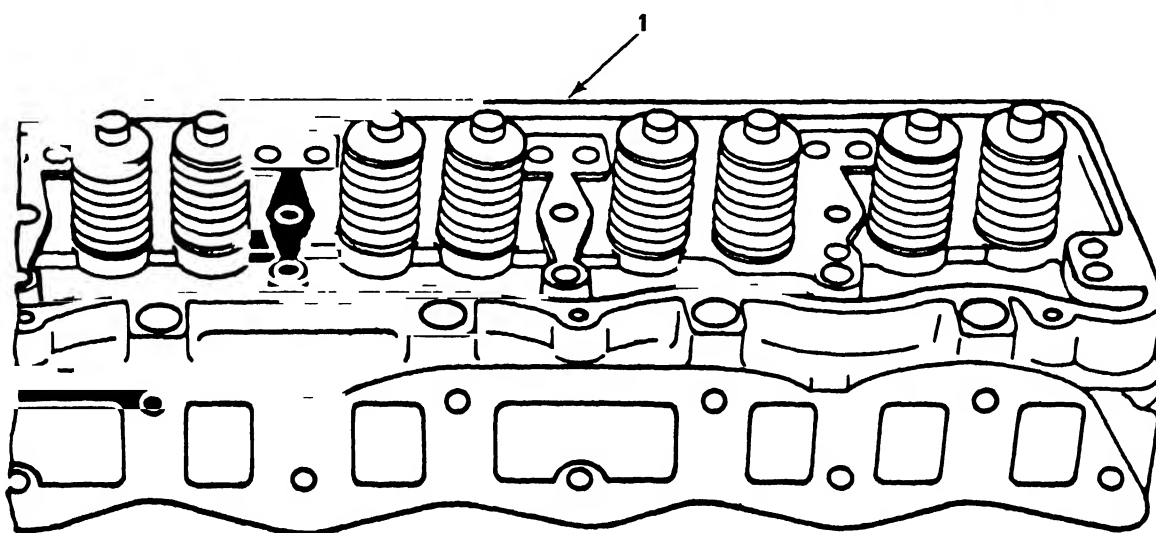
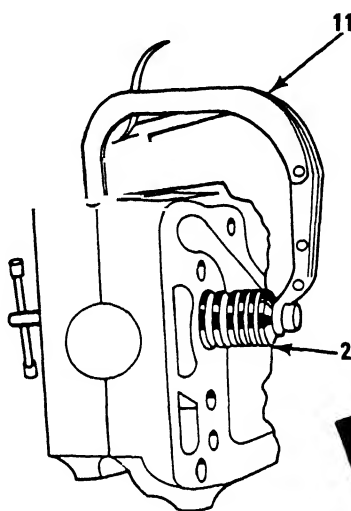
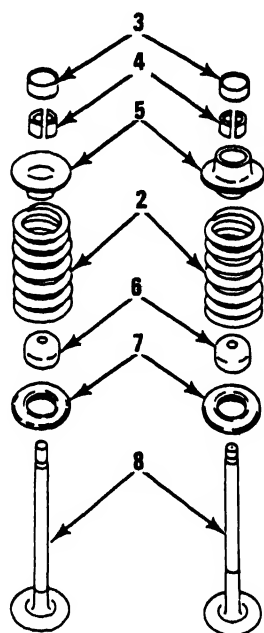
CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)



CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		c Replace cylinder head if warped or cracked	
6.	All other components spring seat (7), spring retainer (5), split collets (4), and valve stem cap (3)	Replace if worn or damaged	
<u>ASSEMBLE</u>			
7	Cylinder head (1)	a Valve guide (9)	Install to correct depth and protrusion in head (see figure)
			Use valve guide installer See figure protrusion for dimensions
	b Valve seat (10)	a Press into head	Use valve seat installer Install with chamfer (beveled) edge away from combustion chamber
		b Cut seat (30°) to give maximum valve protrusion 0.034 in (0.86 mm) above head	Use valve seat grinding kit

CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)



CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		c. Recut old seat if valve guide replaced to ensure concentricity.	Use valve seat grinding kit.
	c. Cylinder head (1)	a. Place on side. b. Clean valve guide bores.	
	d. Valve (8)	a. Lubricate stem with clean engine oil. b. Insert in correct position, valve head against seat.	If reusing original valves make sure they are installed in their original bores
	e. Valve spring seat (7)	Install on valve stem	
	f. Oil seal (6)	Install on valve stem.	
	g. Valve spring (2)	Place over stem and oil seal (6).	
	h. Spring retainer (5)	Place on spring	
	i. Valve spring (2)	Compress.	Use valve spring compressor.

CYLINDER HEAD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	j. Split collets (4)	Place in valve stem collet grooves.	
	k. Valve spring (2)	Release compres- sion engaging collets with spring retainers.	
	l. Valve stem cap (3)	Fit on valve stem.	

CYLINDER HEAD ASSEMBLY REPLACEMENT INSTRUCTIONS

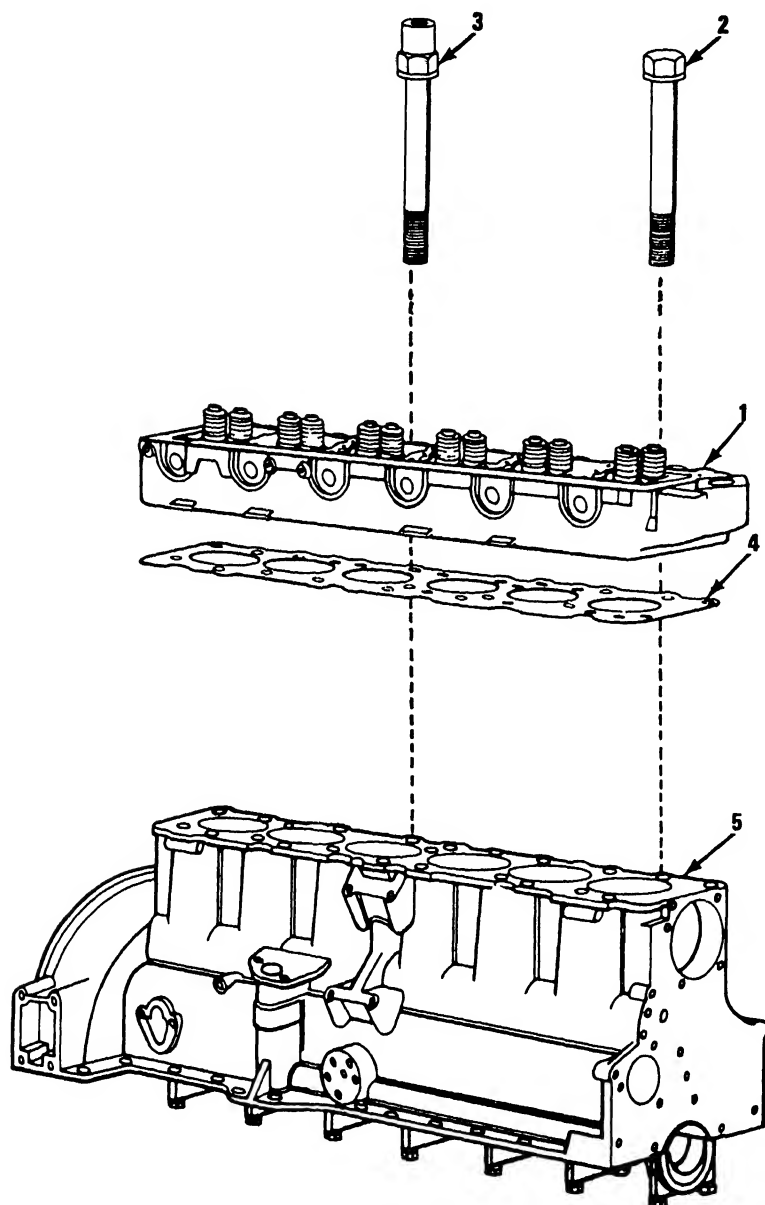
This task covers

- a Removal
- b Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Ratchet with 1/2 in drive	TM 5-1940-277-20	Cooling system drained
6 in extension	TM 5-1940-277-20	Air cleaner removed.
3/4 in socket	TM 5-1940-277-20	Turbocharger removed
Torque wrench (0 - 175 ft-lb)	TM 5-1940-277-20	Header tank/heat exchanger removed
Air compressor	TM 5-1940-277-20	Intercooler removed
Air blow gun	TM 5-1940-277-20	Manifolds removed
Putty knife	TM 5-1940-277-20	Fuel filter assembly and transmission oil cooler with bracket removed
Safety goggles		
Materials/Parts	TM 5-1940-277-20	Rocker arm shaft assembly and push rods removed
Engine oil		
Cylinder head gasket	TM 5-1940-277-20	Injectors removed
Personnel Required	Two	

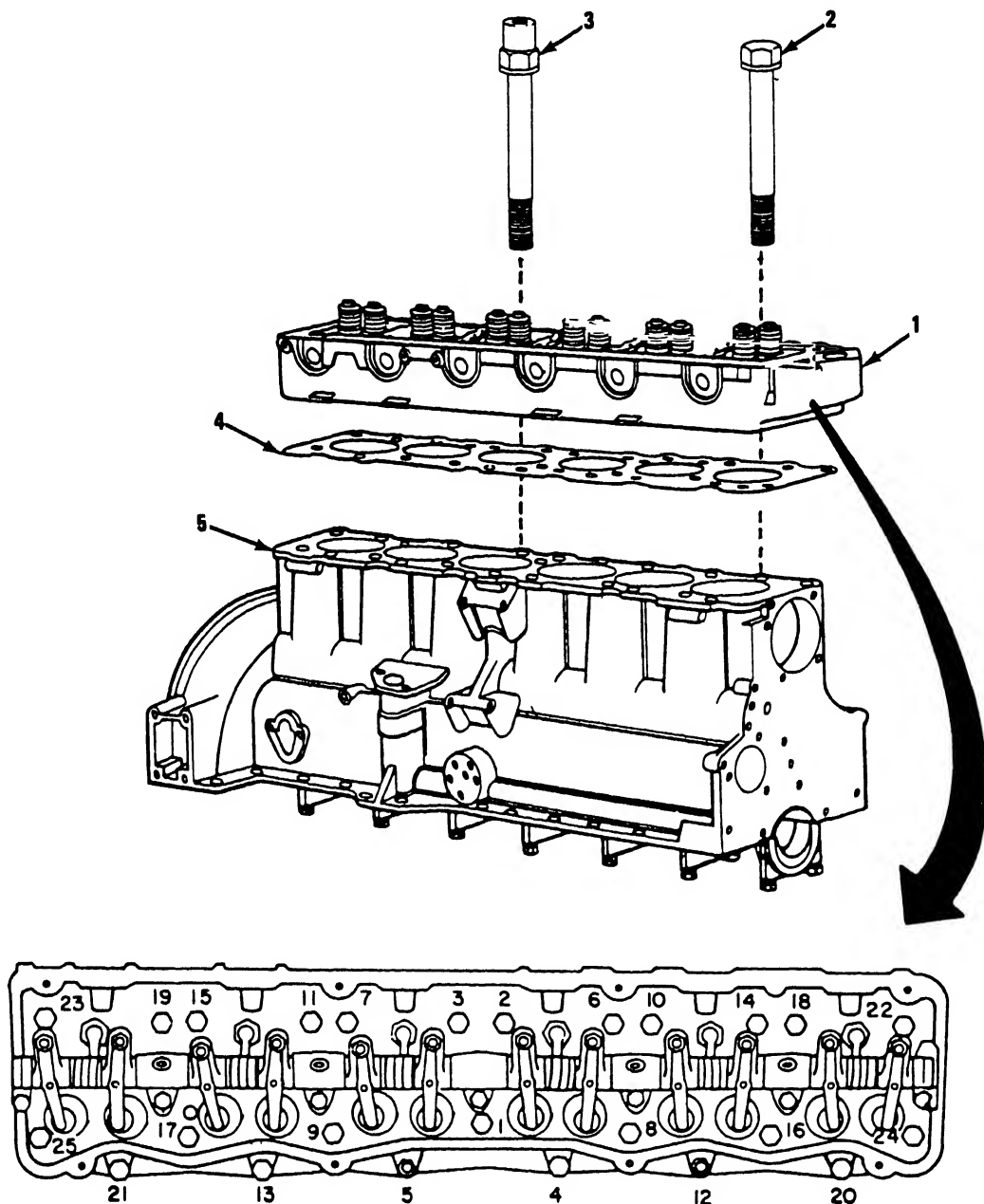
CYLINDER HEAD ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



CYLINDER HEAD ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVE</u>			
1. Cylinder head assembly (1)	a. 23 bolts (2) and 2 bolts (3)	Remove.	Use 3/4 in socket with extension and ratchet
	b. Cylinder head assembly (1)	Remove from cylinder block (2)	Use two persons or lifting device
	c. Head gasket (4)	Remove and discard	
<u>INSTALL</u>			
2. Cylinder head assembly (1)	Cylinder head assembly (1)	Clean all mating surfaces	Use putty knife Make sure surfaces free of carbon buildup, gasket material or other substance
<u>WARNING</u>			
Always use safety goggles when using dry compressed air for cleaning Do not use pressures greater than 30 psi High air pressure can cause injury and cut the skin			
3. Cylinder block (5)	a. Cylinder block (5)	Check, clean and dry all cylinder head bolt holes	Use low air pressure, be careful not to blow any foreign material into cylinders

CYLINDER HEAD ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

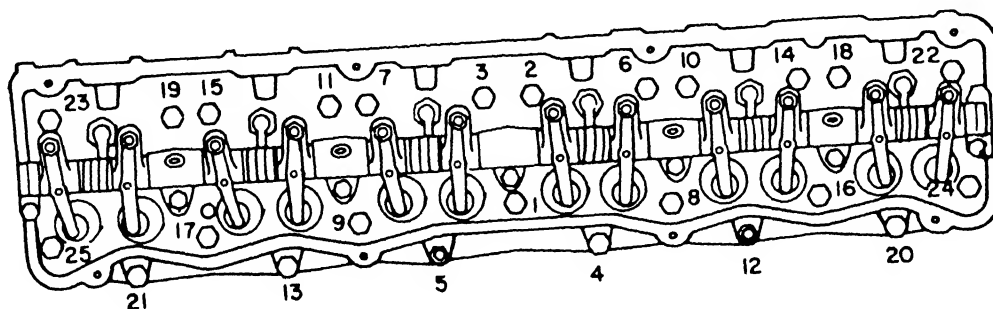
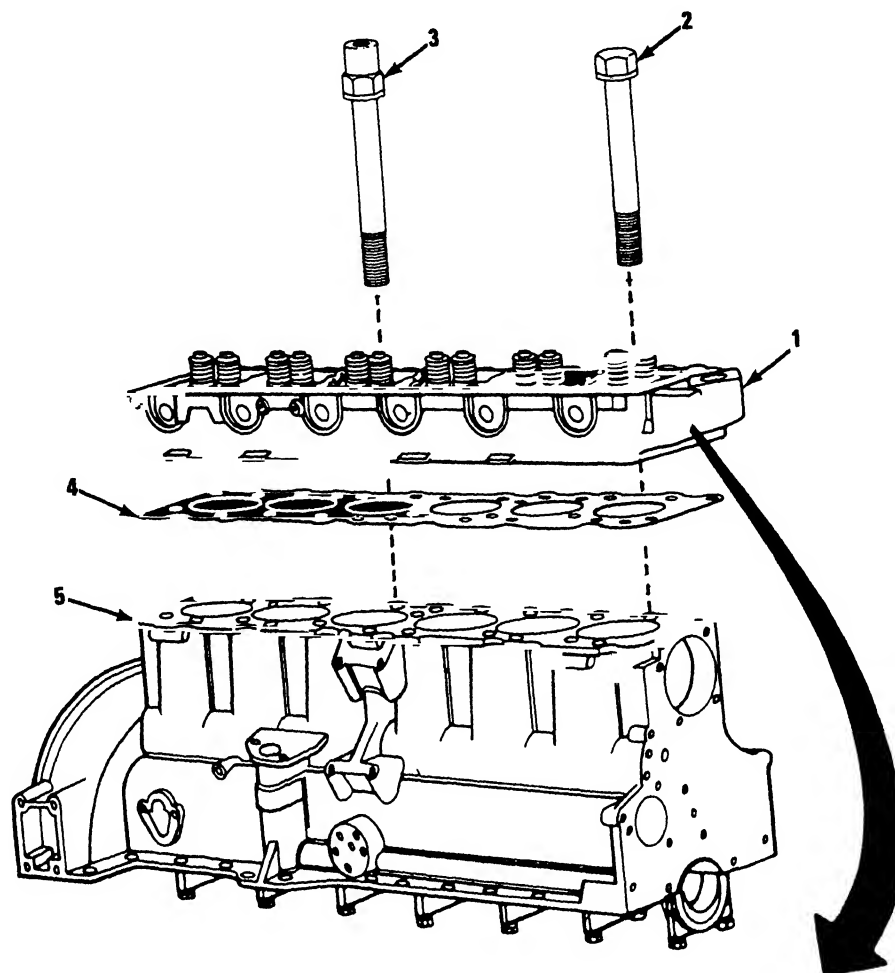


CYLINDER HEAD BOLT TIGHTENING SEQUENCE

CYLINDER HEAD ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	b. Head gasket (4)	a Apply thin smear of clean grease on both sides of gasket. b Position on block over thimble dowels.	
	c Cylinder head assembly (1)	Place in position on block	Use two persons or lifting device. Do not damage gasket.
4	Cylinder head assembly (1)	23 bolts (2) and 2 bolts (3) a Smear threads and underside of bolts liberally with clean engine oil b Install finger tight	Make sure two extension bolts (5) for mounting intercooler are in numbers 5 and 12 positions
<u>CAUTION</u>			
Under no circumstance torque bolts more than specified fatigue may result			Severe metal
		c Torque bolts evenly in sequence to 50 ft-lb then to 95 ft-lb.	Use 3/4 in socket and torque wrench. Turn each bolt in sequence 1/2 turn at a time until specified torque reached

CYLINDER HEAD ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

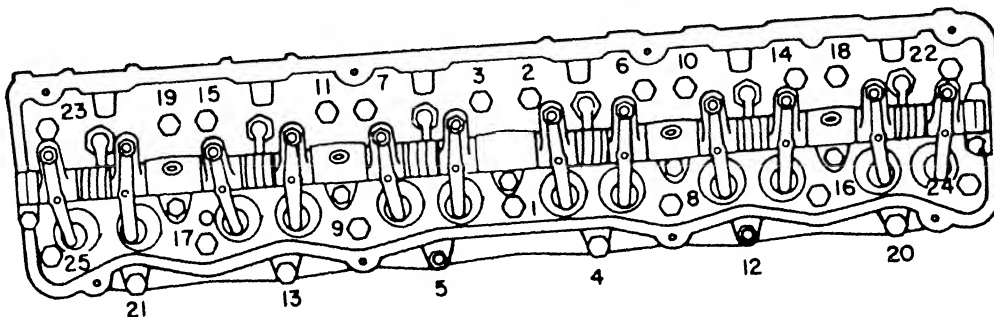
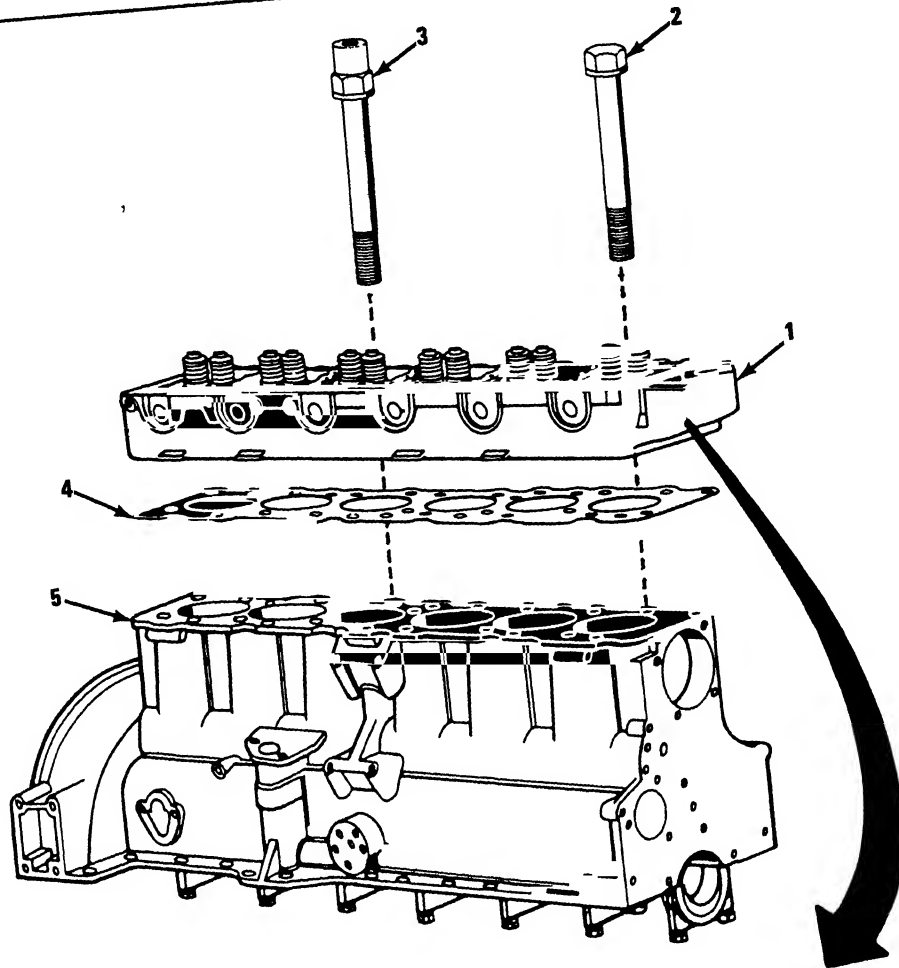


CYLINDER HEAD BOLT TIGHTENING SEQUENCE

CYLINDER HEAD ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

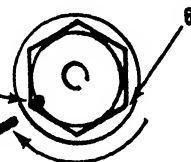
LOCATION	ITEM	ACTION	REMARKS
		d. Reassemble engine in accordance with instructions	See equipment Conditions References (See page 2-269)
<p style="text-align: center;"><u>CAUTION</u></p> <p>Do not start or operate engines with boat out of water. Severe engine damage will result.</p>			
5	Engine assembly	Engine assembly	<p>a Start and operate engine until water temperature reaches 60-70°C</p> <p>See TM 5-1940-277-10 for starting procedures</p>
<p style="text-align: center;"><u>NOTE</u></p> <p>Perform the following task while the engine is still hot</p>			
		b Remove inter-cooler	See TM 5-1940-277-20
		c Remove rocker arm cover	See TM 5-1940-277-20
		d Remove rocker arm assembly	See TM 5-1940-277-20
6.	Cylinder head assembly (1)	Each cylinder head bolts in turn using numbering sequence shown	<p>a Loosen bolt (2) and (3).</p> <p>b. Re-torque Use 3/4 in</p>

CYLINDER HEAD ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)



CYLINDER HEAD BOLT TIGHTENING SEQUENCE

Mark bolt head
corner and
adjacent surface



Turn until this
corner reaches mark

CYLINDER HEAD ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		bolt to 50 ft-lb.	socket and torque wrench
		c Wipe the area of cylinder head around bolt free of oil	
		d Mark one corner of bolt and adjacent cylinder head surface	See illustration
		e Tighten bolt until next corner (6) but one reaches the mark	See illustration
		f Reinstall rocker arm assembly	See TM 5-1940-277-20
		g Adjust valve	See TM 5-1940-277-20
		h Reinstall rocker arm cover	See TM 5-1940-277-20
		i Reinstall intercooler	See TM 5-1940-277-20.



CYLINDER HEAD ASSEMBLY - VALVE SPRING REPLACEMENT INSTRUCTIONS

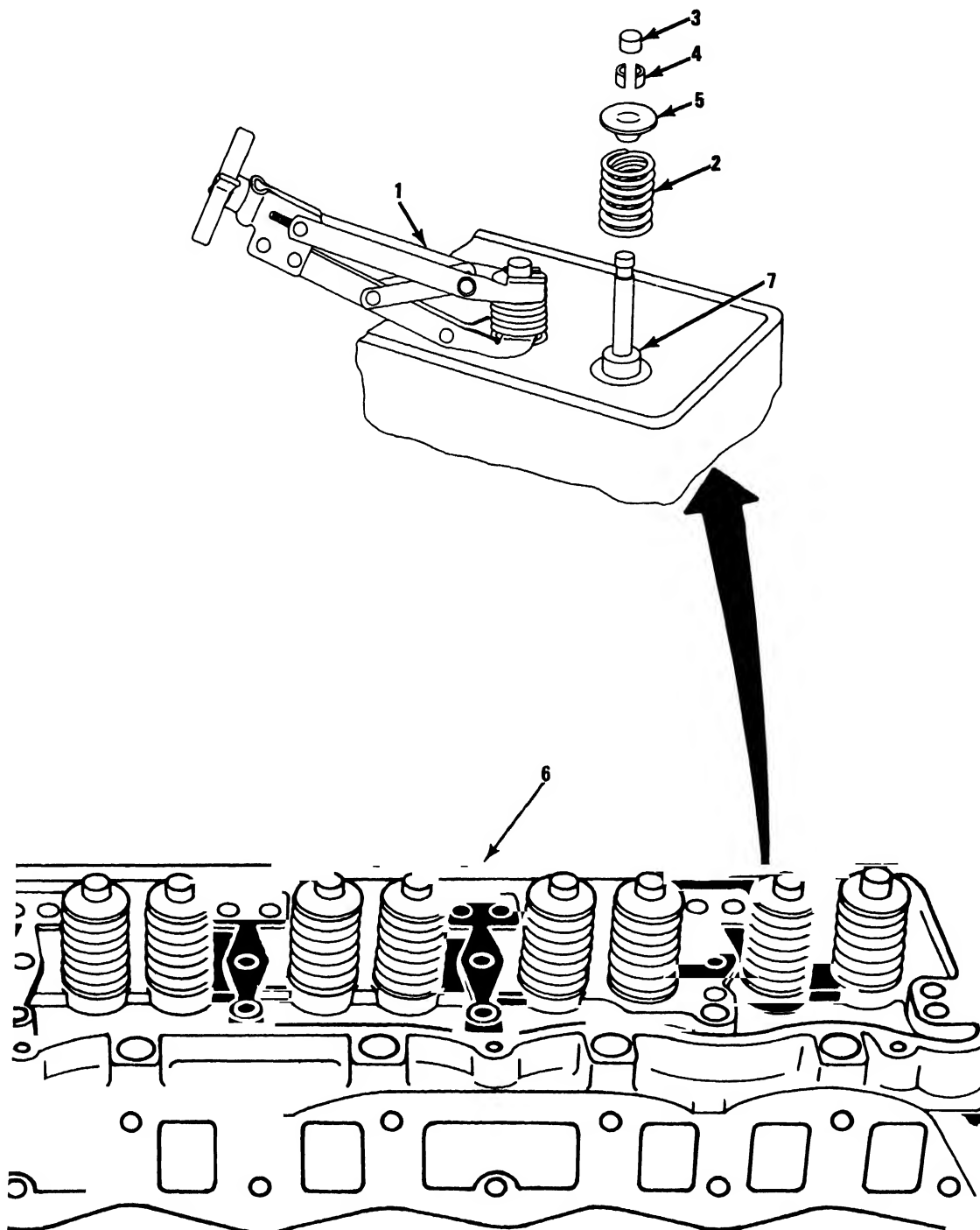
This task covers

- a. Removal (Cylinder head not removed from engine)
- b. Installation (Cylinder head not removed from engine)

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Valve spring lifter	TM 5-1940-277-20	Intercooler removed.
Materials/Parts	TM 5-1940-277-20	Rocker arm shaft assembly removed.
Valve springs		

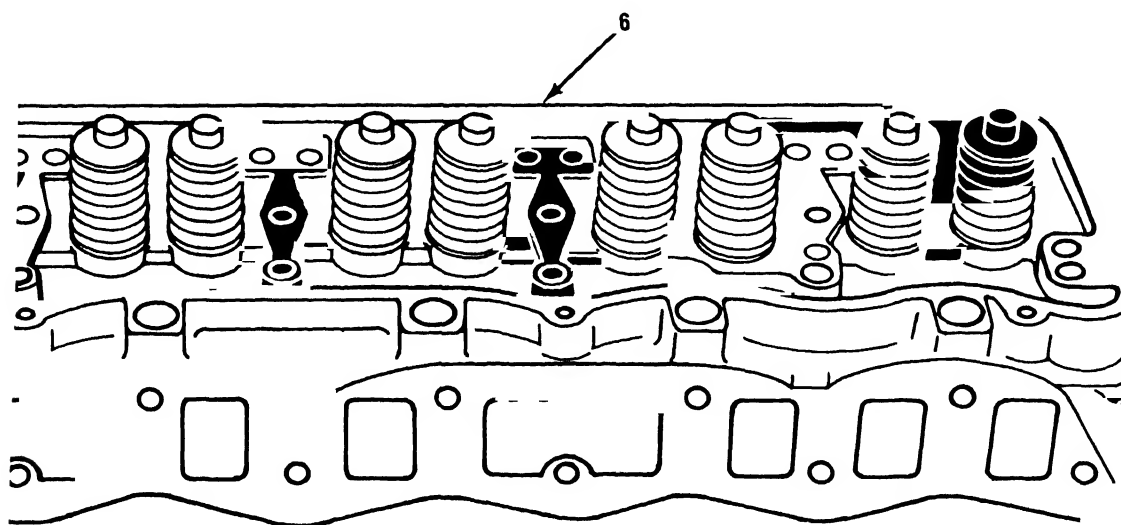
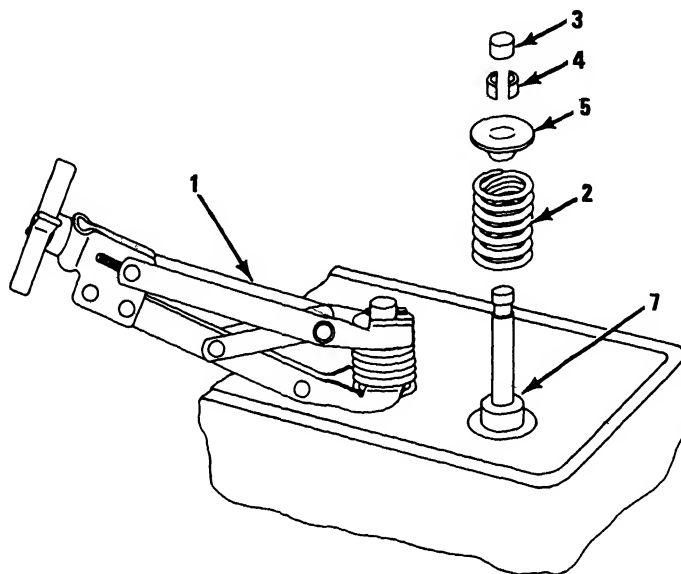
CYLINDER HEAD ASSEMBLY - VALVE SPRING REPLACEMENT INSTRUCTIONS
(Continued)



CYLINDER HEAD ASSEMBLY - VALVE SPRING REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
NOTE			
Piston at which valve spring is to be replaced must be at top dead center (refer to Timing Procedures, TM 5-1940-277-20).			
<u>REMOVAL</u>			
1. Cylinder head assembly (6)	a. Valve spring (2)	Compress	Use valve spring lifter (1).
	b. Valve stem cap (3)	Remove.	
	c. Split collets (4)	Extract.	
	d. Valve spring (2)	Release compression.	
	e. Spring retainer (5)	Remove	
	f. Valve spring (2)	Remove.	
<u>INSTALLATION</u>			
2. Cylinder head assembly (6)	a. New valve spring (2)	Place over stem and oil seal (7).	
	b. Spring retainer (5)	Place on spring.	
	c. Valve spring (2)	Compress.	Use valve spring lifter (1).

CYLINDER HEAD ASSEMBLY - VALVE SPRING REPLACEMENT INSTRUCTIONS
(Continued)



CYLINDER HEAD ASSEMBLY - VALVE SPRING REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	d. Split collets (4)	Place in valve stem collet grooves.	
	e. Valve spring (2)	Release compression engaging collets with spring retainer.	
	f. Valve stem cap (3)	Fit on valve stem.	



2 4



1

11



OIL SUMP (PAN) INSPECTION AND REPLACEMENT INSTRUCTIONS

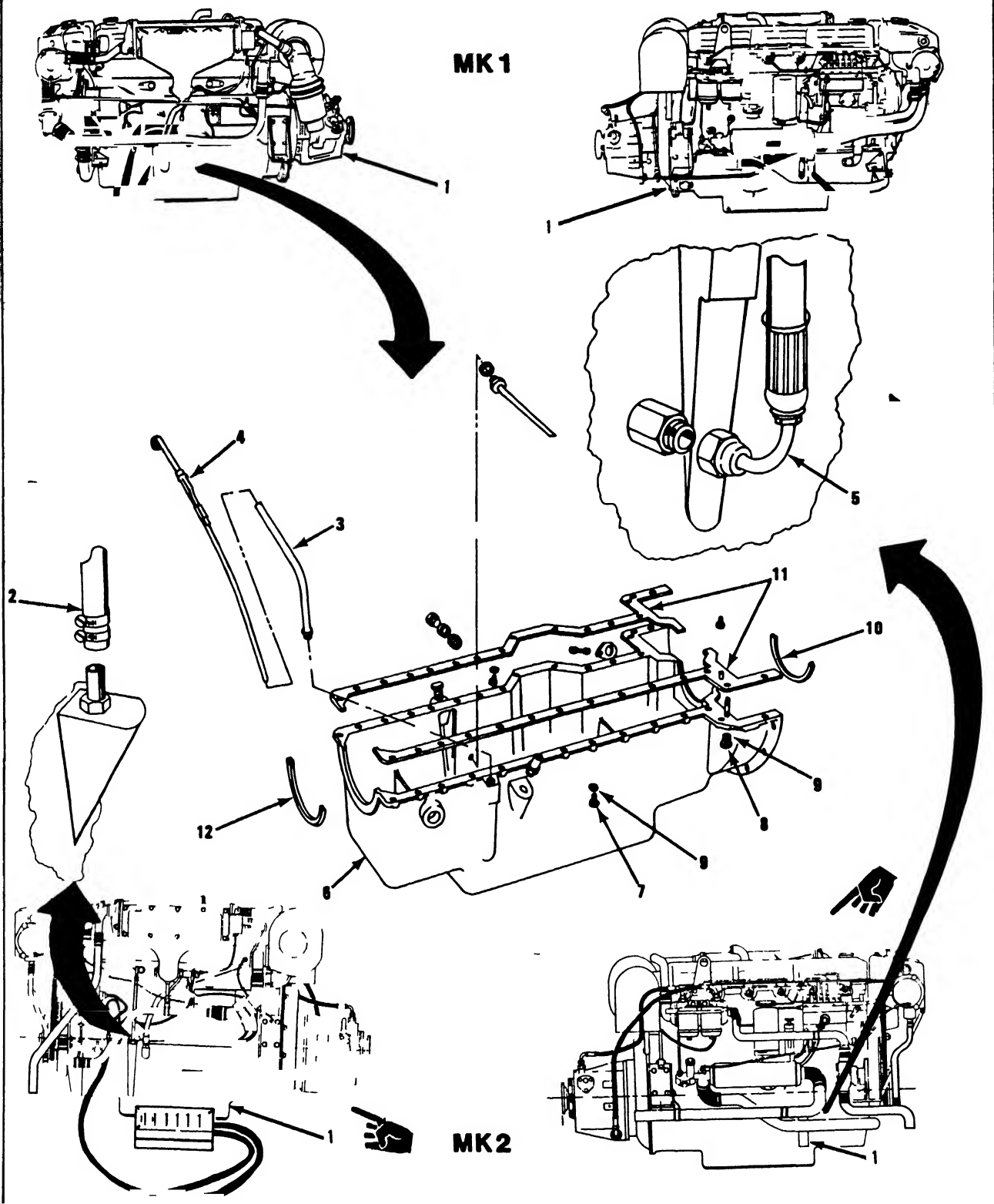
This task covers

- | | |
|---------------|---|
| a. Removal | c Transfer of parts to replacement sump |
| b. Inspection | d Installation |

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Ratchet	Page 2-179	Engine assembly removed from boat and mounted on engine maintenance stand or laid on side on top of work bench
6 in extension		
9/16 in socket		
3/4 in open end wrench		
7/8 in open end wrench		
1-1/8 in open end wrench	Page 2-345	Transmission removed
15/16 in box wrench	TM 5-1940-277-20	Engine oil drained
Flat tip screwdriver	TM 5-1940-277-20	Cooling system drained
1/2 in box wrench	Page 2-317	Flywheel housing cover removed
3/8 in universal joint		
Materials/Parts		
Oil sump		
Oil sump gasket set		
Lockwasher		
O-ring, sump pump suction type		
Engine oil		
Silicone sealant		

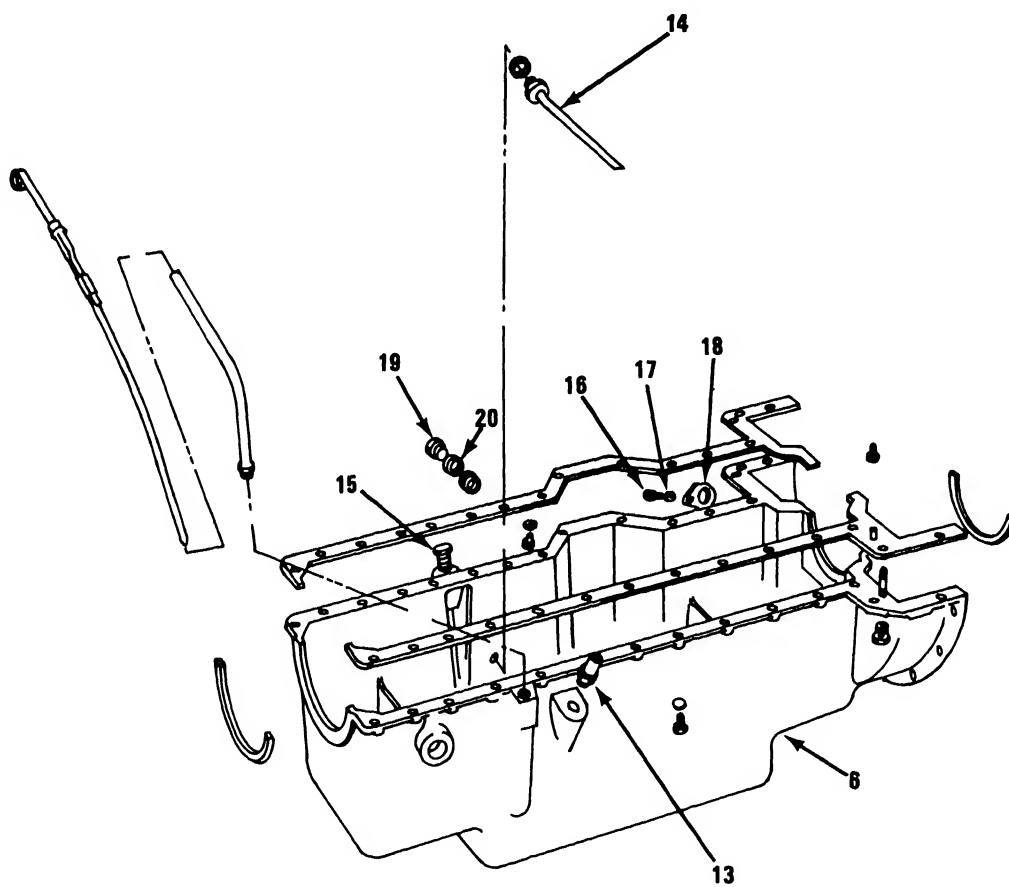
OIL SUMP (PAN) INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)



OIL SUMP (PAN) INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1	Engine assembly (1)	a Turbocharger oil drain pipe (2)	Loosen clamp and disconnect. Use screwdriver.
		b. Dipstick tube (3) and dipstick (4)	Remove Use 3/4 in open end wrench.
		c Sump pump hose and end fittings assembly (5)	Disconnect at oil sump end Use 7/8 in open end wrench
		d Engine assembly (1)	Invert on maintenance stand or laid on side on top of work bench
2	Oil sump (6)	a 25 capscrews (7), 4 nuts (8) and 29 washers (9)	Remove Use 9/16 in socket, 6 in extension, ratchet and universal joint
		b Oil sump (6)	Remove and set aside
		c Gaskets (11) and seals (10 and 12)	Remove and discard
<u>INSPECTION</u>			
3	Oil sump (6)	a Visually inspect for cracks, distortions.	

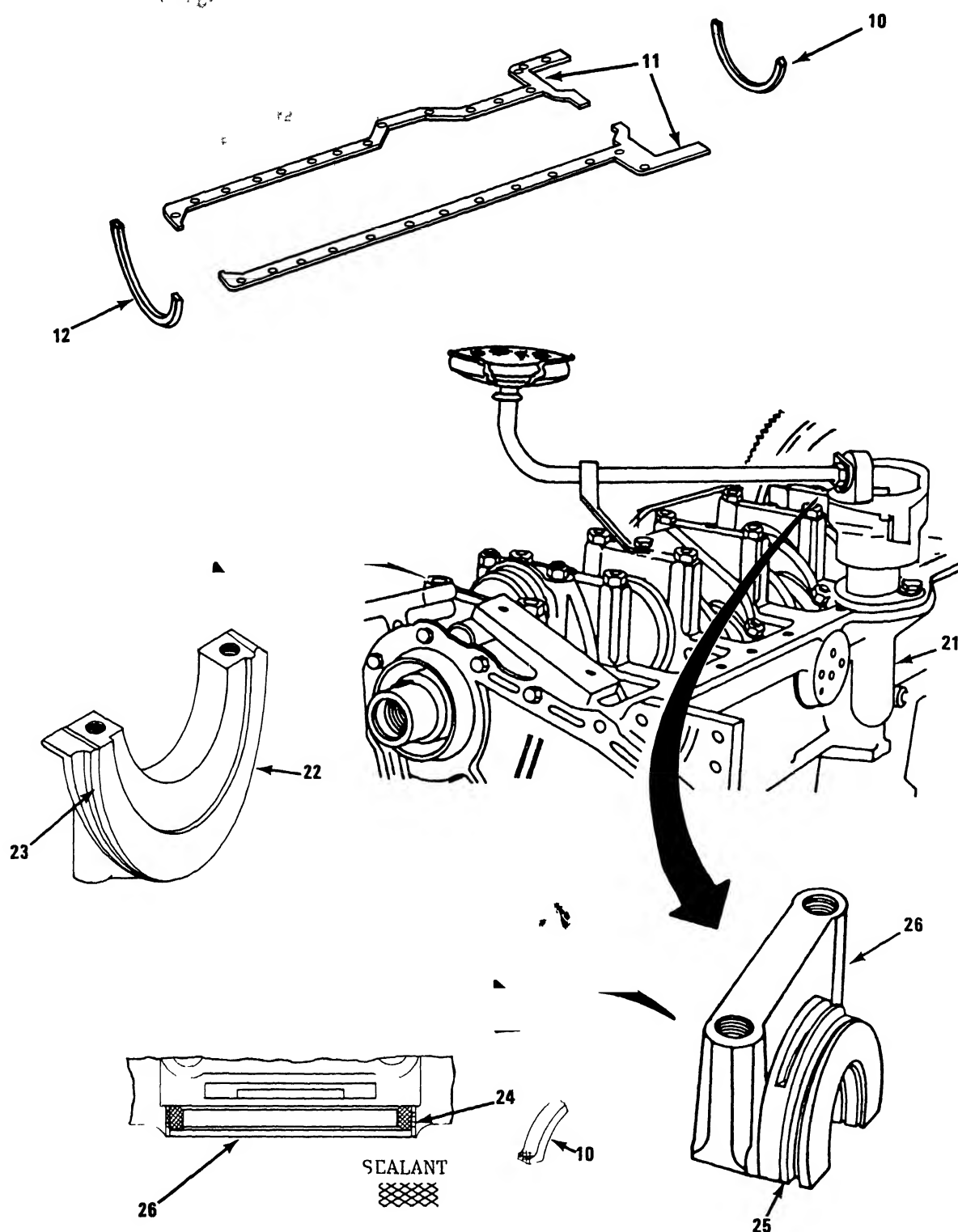
OIL SUMP (PAN) INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



OIL SUMP (PAN) INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. Replace sump if any defects noted.	
<u>TRANSFER OF PARTS TO REPLACEMENT SUMP</u>			
4. Oil sump (6)	a. Turbocharger oil drain adapter (13)	Transfer (remove from old sump and install on new sump).	Use 1-1/8 in open end wrench
	b. Sump pump adapter, male, and suction pipe (14)	Transfer, replace O-ring	Use 7/8 in open end wrench
	c Dipstick blanking plug (15)	Transfer	Use 3/4 in open end wrench
	d Setscrew (16), lock-washer (17) and timing hole cover (18)	Transfer	Use 1/2 in box wrench
	e Drain plug (19) and washer (20)	Transfer	Use 15/16 in box wrench

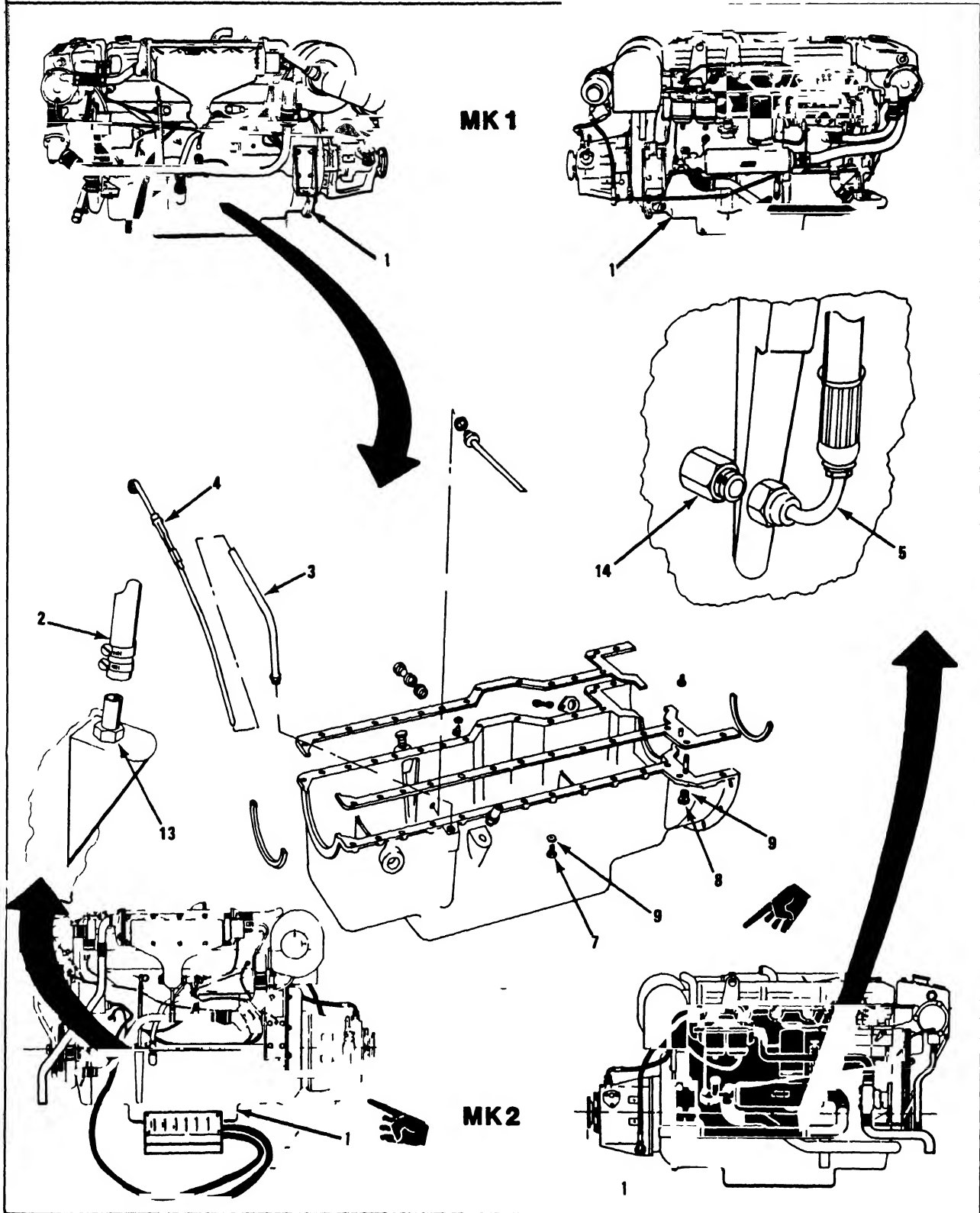
OIL SUMP (PAN) INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)



OIL SUMP (PAN) INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
5. Cylinder block (21)	a. Oil sump gasket (11)	a. Apply sealant to both sides of gasket.	Use silicone sealant.
		b. Fit gasket to face of block using dowels for positioning.	
		c. Apply sealant in space for gasket in front oil seal groove (23) around front main bearing cap (22).	
	b. Front oil seal (12)	Fit in groove in front main bearing cap (23)	Take care not to trap timing gear housing gasket.
	c. Rear oil seal (10)	a. Make sure area (24) under seal feet is free of sealant	
		b. Apply thin coat of sealant as shown	
		c. Fit in groove (25) in rear main bearing cap (26).	
	d. Oil sump (6)	Position on block.	

OIL SUMP (PAN) INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



OIL SUMP (PAN) INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
6 Engine assembly (1)	e 25 capscrews (7), 4 nuts (8) and 29 washers (9)	Install and tighten	Use 9/16 in socket, 6 in extension, ratchet and universal joint
	a Engine assembly (1)	Return to upright position, either in engine maintenance stand or on blocks	
	b Dipstick (4) and dipstick tube (3)	Install	Use 3/4 in open end wrench
	c Sump pump hose and end fittings assembly (5)	Connect to adapter (14) on sump	Use 7/8 in open end wrench
	d Turbocharger oil drain pipe (2)	Fit on adapter (13) and tighten clamp	Use screwdriver

[illegible]

FLYWHEEL AND HOUSING REPLACEMENT INSTRUCTIONS

This task covers

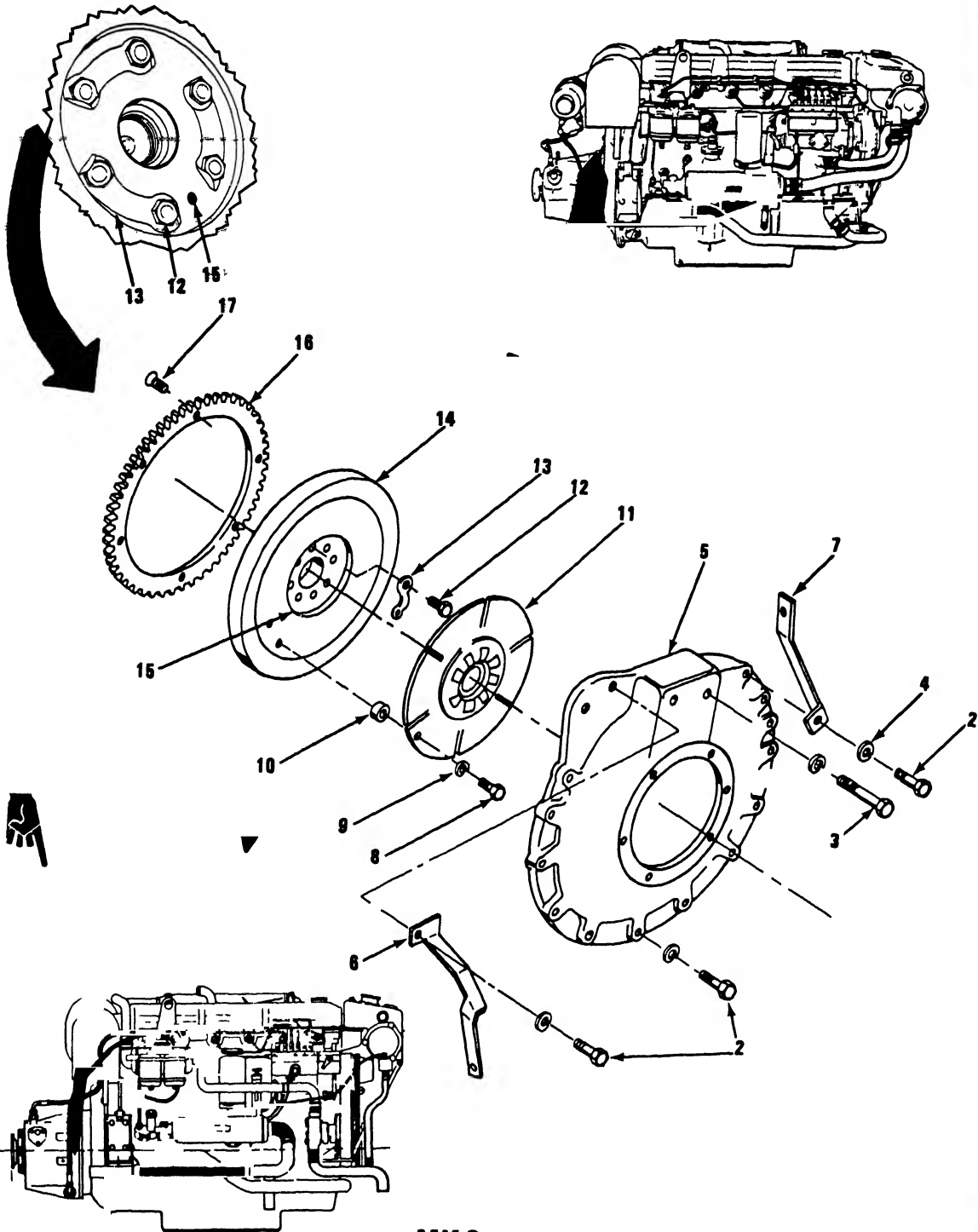
- a Removal
- b Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
9/16 in socket, 1/2 in drive		
5/8 in box wrench	Page 2-179	Engine removed from boat and mounted on blocks.
3/8 in drive ratchet		
5/8 in socket, 3/8 in drive	Page 2-345	Transmission removed
1/2 in socket, 3/8 in drive	TM 5-1940-277-20	Air cleaner removed.
1/2 in drive ratchet		
3/4 in socket, 1/2 in drive		
Torque wrench, (0 - 150 lb-ft), 1/2 in drive		
Slip joint pliers		
Runout indicator dial		
Honing stone		
Cross tip screwdriver		
Hammer		
Chisel		
Materials/Parts		
Lockwashers		
Locktabs		
Blocks		
Personnel Required	Two	

FLYWHEEL AND HOUSING REPLACEMENT INSTRUCTIONS
(Continued)

MK1



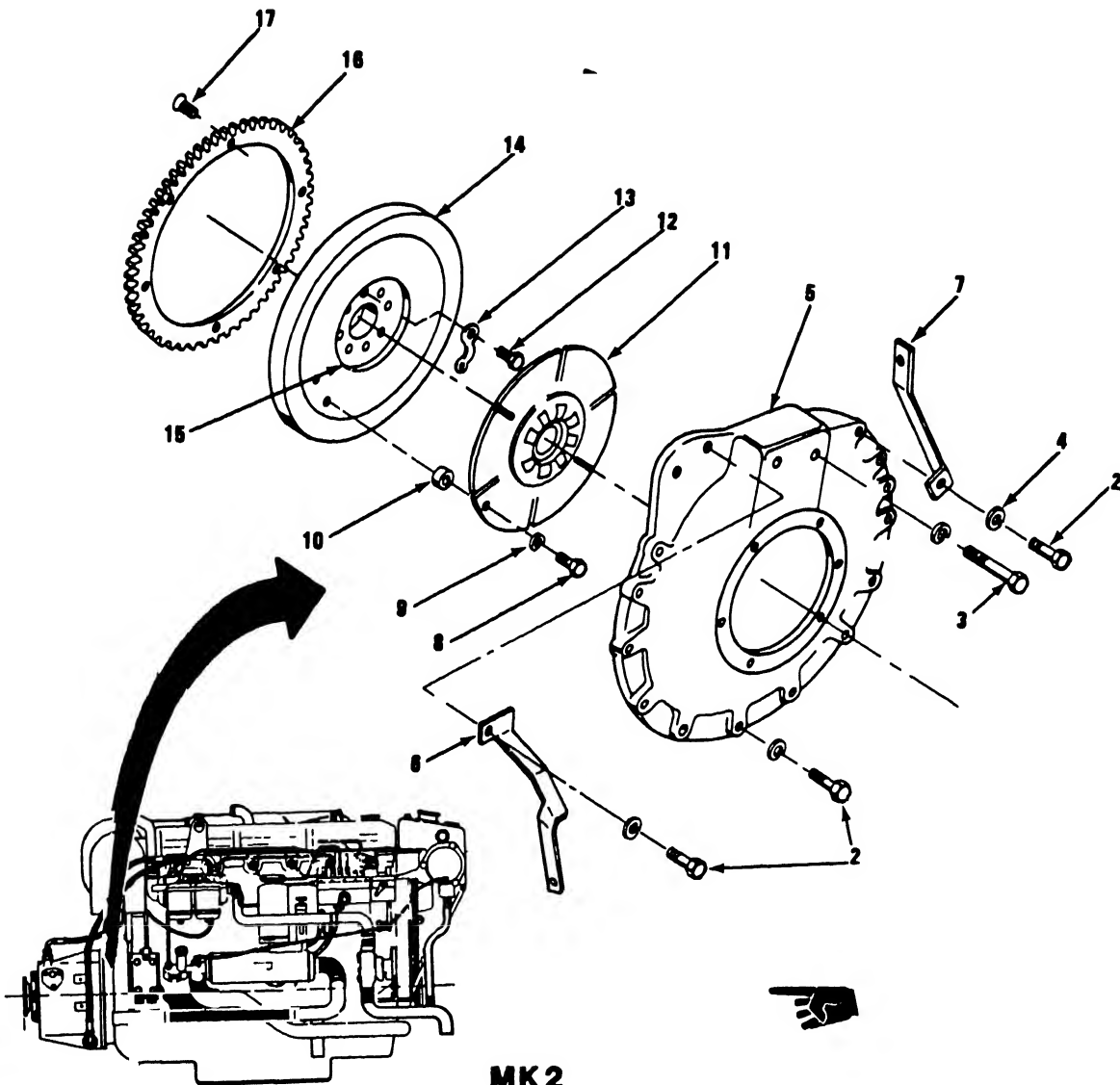
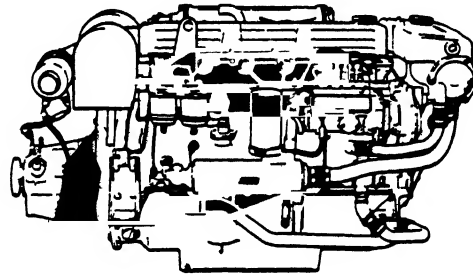
MK2

FLYWHEEL AND HOUSING REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
1. Flywheel and housing assembly (1)	a. 13 setscrews (2), 2 bolts (3), 15 lockwashers (4), flywheel housing cover (5), gear box control cable bracket (6) and air cleaner housing bracket (7)	a. Unscrew bolts and remove parts secured by bolts. b. Discard lockwashers.	Use 5/8 in box wrench, 5/8 in socket and 3/8 in drive ratchet.
	b. 6 dowel bolts (8), 6 lockwashers (9), 6 washers (10) and damper drive plate (11)	Remove.	Use 1/2 in socket and 3/8 in drive ratchet.
	c. 6 flywheel bolts (12), 3 locktabs (13)	a. Bend back tabs. b. Remove bolts and tabs.	Use hammer and chisel. Use 3/4 in socket and 1/2 in drive ratchet.
	d. Flywheel (14)	a. Screw two 3/8-16 UNC bolts into tapped holes (15).	

FLYWHEEL AND HOUSING REPLACEMENT INSTRUCTIONS
(Continued)

MK 1



MK 2

FLYWHEEL AND HOUSING REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

WARNING

Flywheel weighs 87 lbs. Use two men to lift it. Injury to personnel may result.

b. Jack flywheel Use 9/16 in socket and 1/2 in by tightening drive ratchet. bolts evenly.

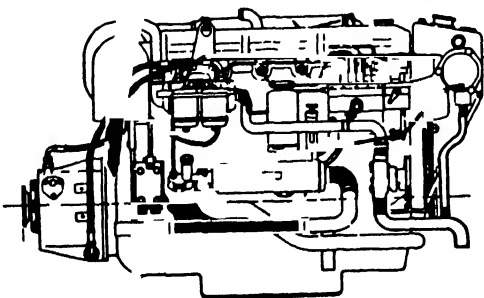
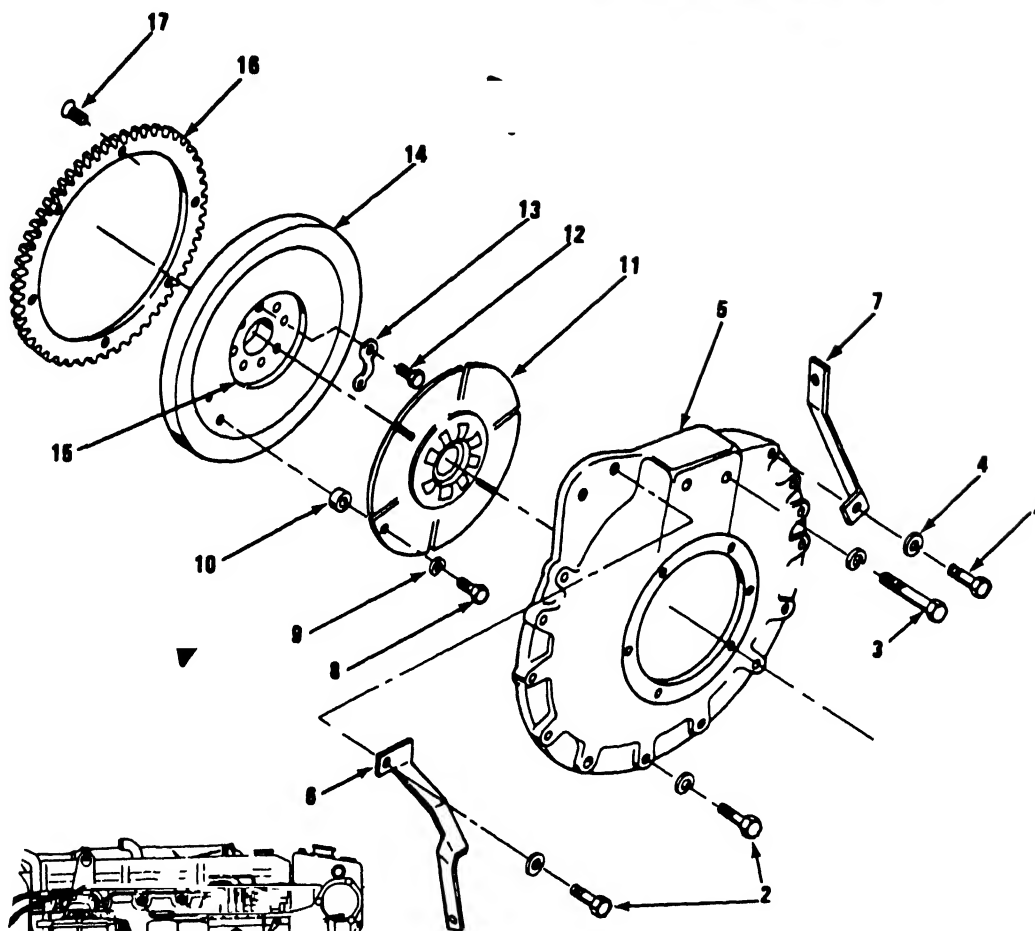
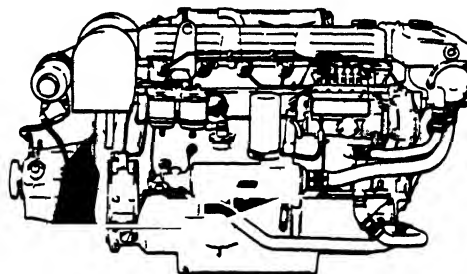
	e. Ring gear (16) and 6 screws (17)	Remove.	Use cross tip screwdriver.
--	-------------------------------------	---------	----------------------------

INSTALLATION

2. Flywheel (14)	Ring gear (16) and 6 screws (17)	Mount gear on flywheel	Use cross tip screwdriver.
3. Engine assembly	a. Crankshaft	Clean crankshaft flange, remove any burrs	Use honing stone
	b. Flywheel (14) and ring gear (16)	a Clean mounting face, remove any burrs.	Use honing stone
		b. Fit to crankshaft, press into place	Do not hammer.

FLYWHEEL AND HOUSING REPLACEMENT INSTRUCTIONS
(Continued)

MK1



MK2

FLYWHEEL AND HOUSING REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

WARNING

Flywheel weighs 87 lbs. Use two men to lift it. Injury to personnel may result.

b. Jack flywheel Use 9/16 in soc-off crankshaft ket and 1/2 in by tightening drive ratchet. bolts evenly.

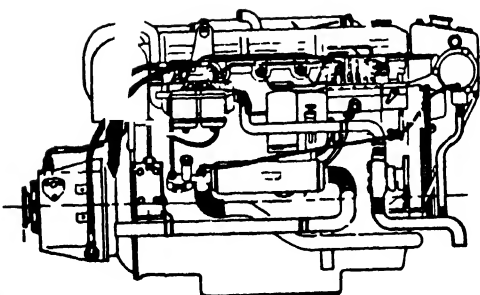
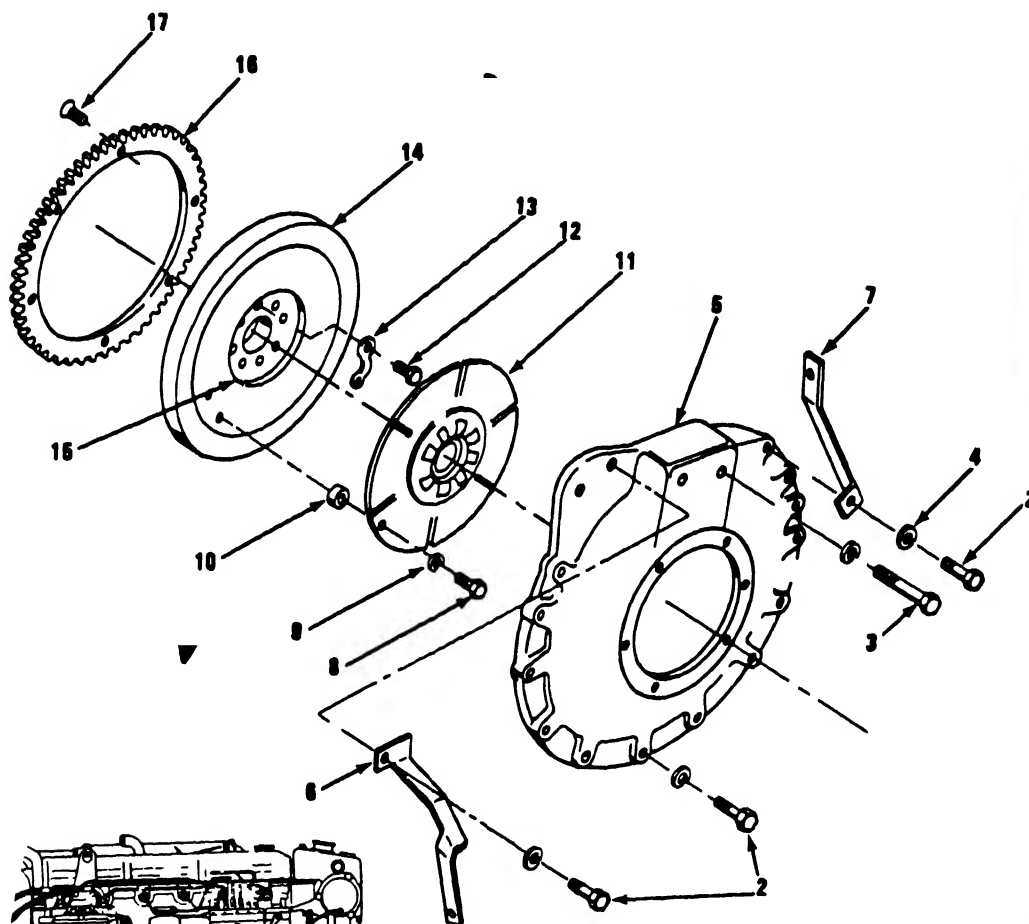
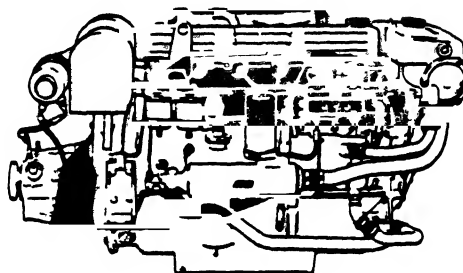
e. Ring gear (16) and 6 screws (17)	Remove	Use cross tip screwdriver.
-------------------------------------	--------	----------------------------

INSTALLATION

2 Flywheel (14)	Ring gear (16) and 6 screws (17)	Mount gear on flywheel.	Use cross tip screwdriver.
3. Engine assembly	a Crankshaft	Clean crankshaft flange, remove any burrs	Use honing stone.
	b Flywheel (14) and ring gear (16)	a Clean mounting face, remove any burrs	Use honing stone
		b Fit to crankshaft, press into place.	Do not hammer

FLYWHEEL AND HOUSING REPLACEMENT INSTRUCTIONS
(Continued)

MK 1



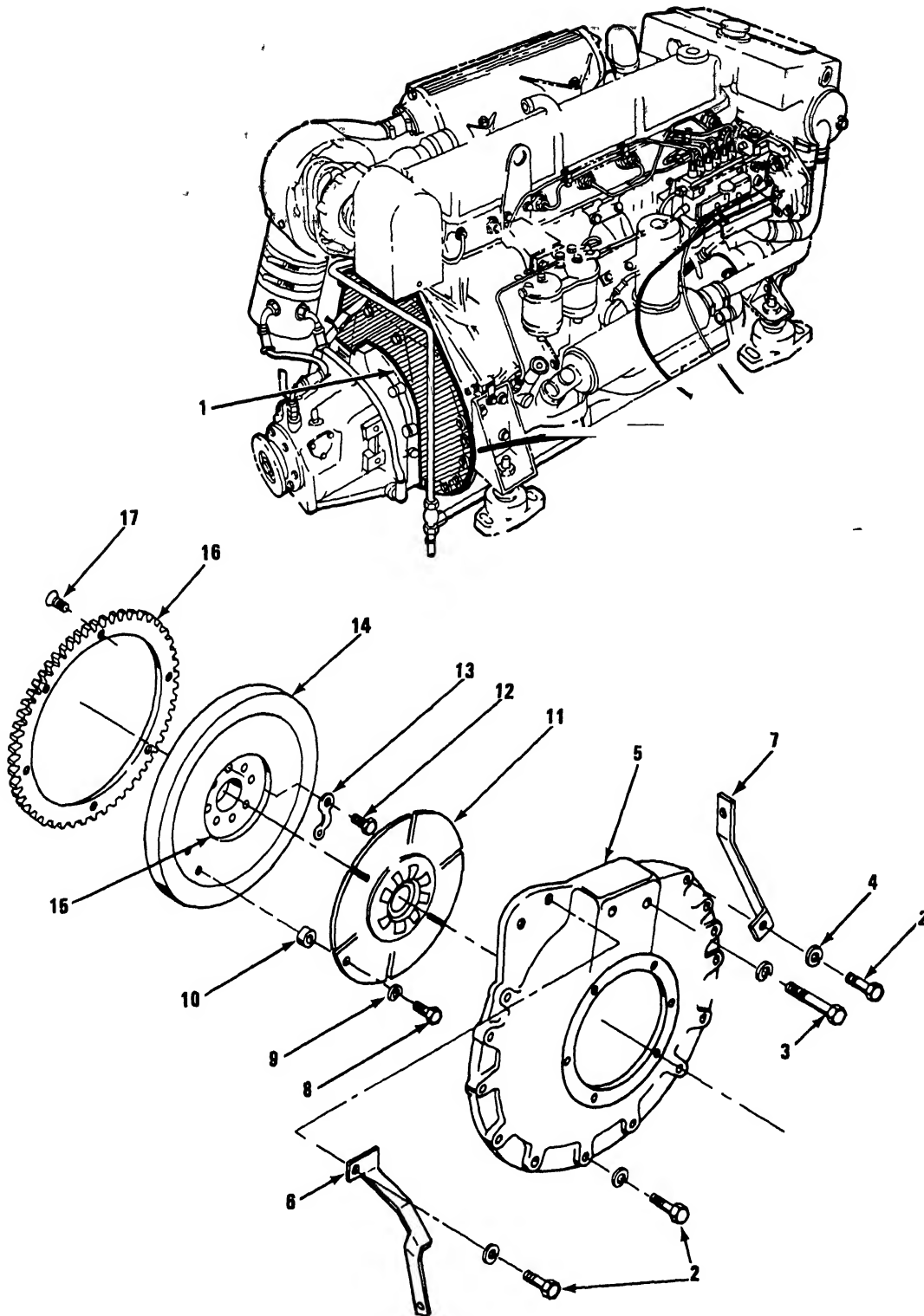
MK 2



FLYWHEEL AND HOUSING REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	c. 6 flywheel bolts (12) and 3 locktabs (13)	a Install	
		b Torque bolts evenly to 80 - 90 ft-lb (11 06 to 12 43 kg/m)	Use 3/4 in socket, 1/2 in drive ratchet and torque wrench, 0 - 175 ft-lb
		c Bend locktabs up	Use hammer and chisel
	d Flywheel (14)	a Check runout at 5 5 inches (13 97 mm) radius Runout not to exceed 0 007 inches (0 178 mm)	Use indicator dial
		b If runout not within limits remove flywheel and recheck crankshaft flange and flywheel mounting face	
		c If runout within limits bend locktabs (13) up securing bolts (12)	Use chisel and hammer

FLYWHEEL AND HOUSING REPLACEMENT INSTRUCTIONS (Continued)



FLYWHEEL AND HOUSING REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	e. 6 dowel bolts (8), 6 lock-washers (9), 6 washers (10) and damper drive plate (11)	Install.	Use 9/16 in socket and 3/8 in drive ratchet.
	f. 13 setscrews (2), 2 bolts (3), 15 lock-washers (4), flywheel housing cover (5), transmission control cable bracket (6) and air cleaner housing bracket (7)	Install.	Use 5/8 in box wrench, 5/8 in socket and 3/8 in drive ratchet

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and the role of the accounting department in ensuring the integrity of the financial statements. It also highlights the need for transparency and accountability in the reporting process.

2. The second part of the document focuses on the various methods used to collect and analyze data, including surveys, interviews, and focus groups. It emphasizes the importance of using a mix of qualitative and quantitative techniques to gain a comprehensive understanding of the research topic.

3. The third part of the document describes the results of the study, including the findings from the data analysis and the conclusions drawn from the research. It also discusses the implications of the findings for practice and policy, and provides recommendations for future research.

4. The final part of the document is a conclusion that summarizes the key points of the study and reiterates the importance of the research findings. It also includes a list of references and a bibliography of the sources used in the study.



VALVE AND SPRING ASSEMBLY REPLACEMENT INSTRUCTIONS

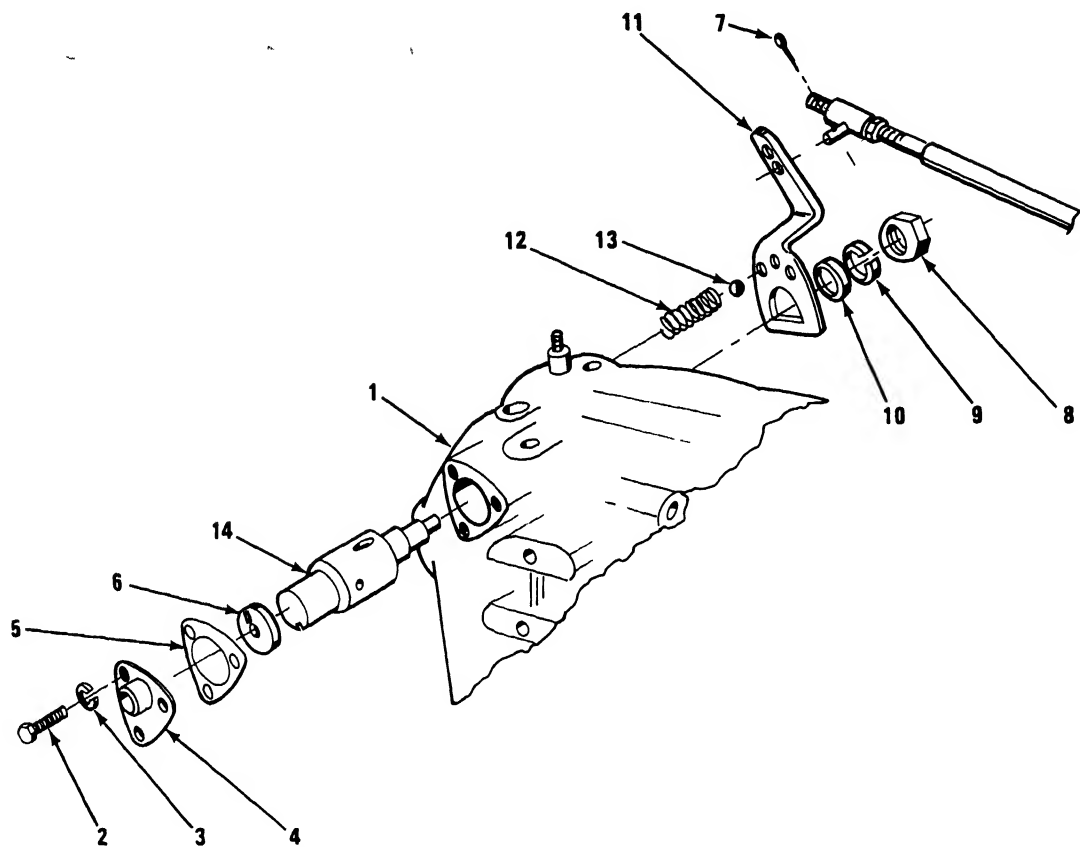
This task covers.

- a. Removal
 - b. Installation
-

INITIAL SETUP

Tools	Equipment Condition	Condition Description
7/16 in open/box wrench 1/2 in open/box wrench Hammer, non-metallic	TM 5-1940-277-20	Engine hatch covers open
Materials/Parts		
Gaskets		
Oil		
Valve and spring assembly		
Silicone sealant		

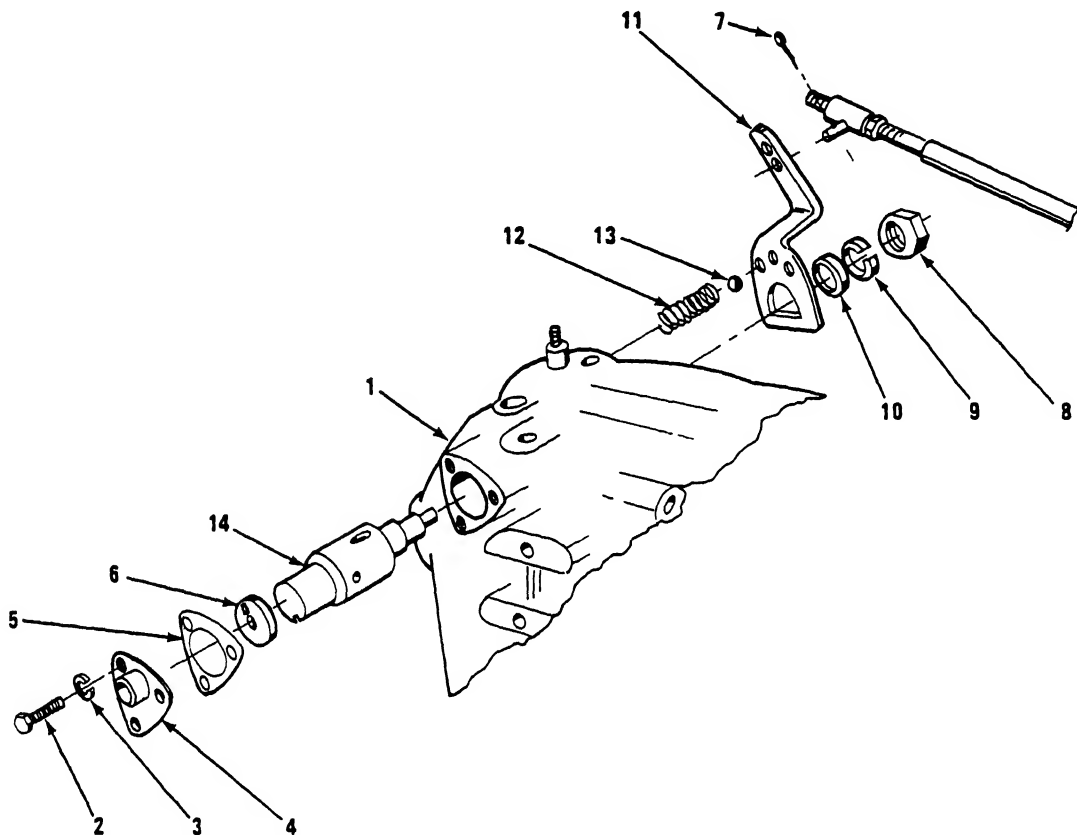
VALVE AND SPRING ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



VALVE AND SPRING ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

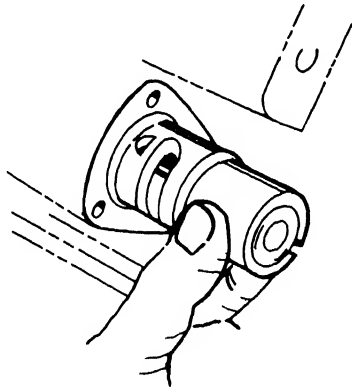
LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1. Transmission (1)	a. 3 valve cover cap screws (2) and 3 washers (3)	Remove.	Use 7/16 in wrench
	b. Valve cover (4)	Remove.	
	c. Valve cover gasket (5)	Discard	
	d. Switch cam (6)	Remove	
	e. Control linkage cotter pin (7)	a. Remove b. Disconnect control linkage	Use long nose pliers
	f. Shift lever retaining nut (8), lockwasher (9), and control lever washer (10)	Remove	Use 1/2 in wrench The poppet spring behind shift lever may push lever off as nut is removed
	g. Shift lever (11)	Remove	Do not let poppet and steel ball fly out
	h. Poppet spring (12), ball (13)	Remove	

VALVE AND SPRING ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



VALVE AND SPRING ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	i Valve and spring assembly (14)	Tap threaded shaft that held shift lever and pull valve out of case through valve cover opening	Use non-metallic hammer
<u>INSTALLATION</u>			
2 Transmission (1)	a Valve and spring assembly (14)	With threaded end first place valve assembly into hole on right rear of transmission Push valve in until it bottoms against the shoulder in case bore	Valve should only require hand pressure to fit into case
	b Valve and spring assembly (14)	Align the slot in control valve with the bottom bolt hole for the valve cover	



10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

TRANSMISSION OIL PUMP REPLACEMENT INSTRUCTIONS

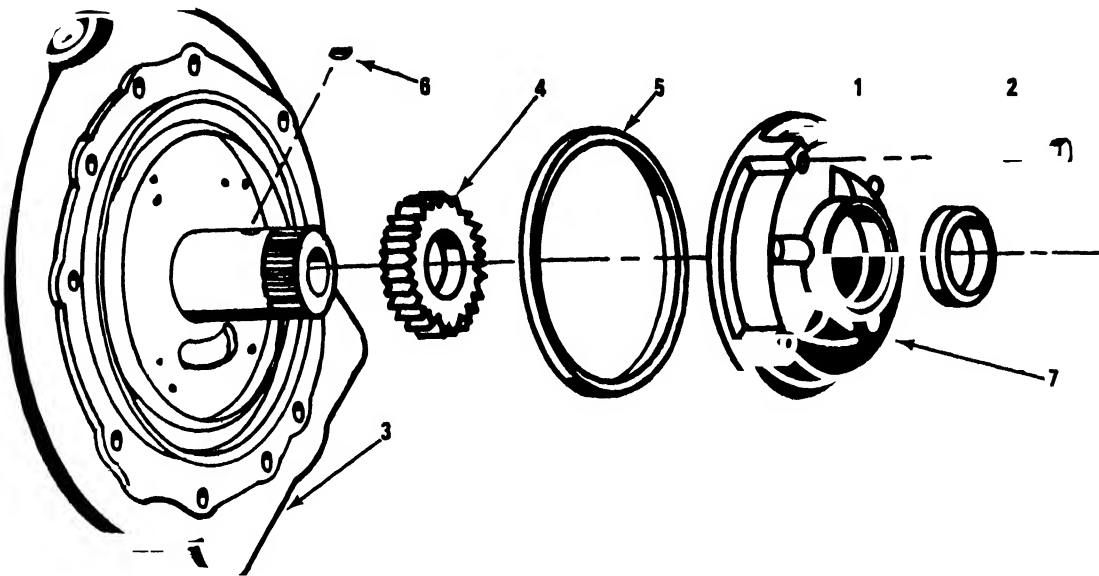
This task covers

- a. Removal
- b. Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
1/2 in socket	Page 2-345	Transmission removed
Ratchet		
Seal puller		
Arbor press		
Screwdriver		
Special Tools		
Oil pump seal sleeve		
Torque wrench (0 - 175 ft-lb)		
Materials/Parts		
Seal		
Gasket		
Silicone sealant		
Oil, OE 30		

TRANSMISSION OIL PUMP REPLACEMENT INSTRUCTIONS
(Continued)



TRANSMISSION OIL PUMP REPLACEMENT INSTRUCTIONS (Continued)

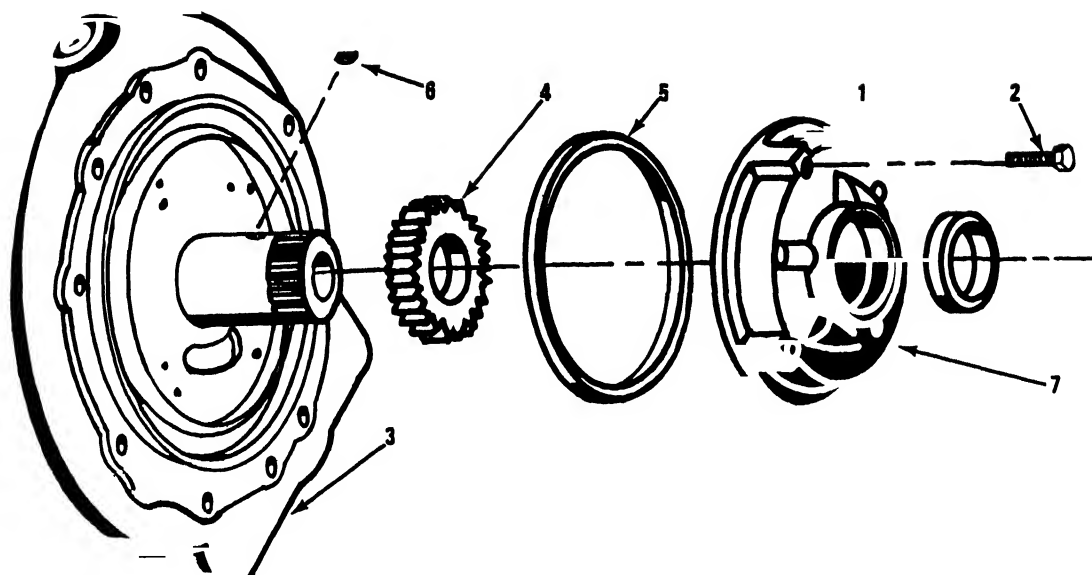
LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1. Front pump housing (1)	4 attaching bolts (2)	Remove	Use 1/2 in socket with ratchet
2 Transmission (3)	Front pump housing (1)	Slide pump assembly squarely off shaft.	Drive gear will stay on shaft
3 Transmission (3)	a Drive gear (4)	Pull gear off shaft	Use hands
	b Front pump gasket (5)	Remove and discard	Use hands
	c Woodruff key (6)	Remove from slot in shaft and retain for use in installation	Use screwdriver
<u>ASSEMBLY</u>			
<p style="text-align: center;">NOTE</p> <p>A new oil pump will come complete with oil seal. If the pump has been removed for a reason other than to replace the pump, the oil seal should be replaced before installing the pump. Steps 9a and 9b do not apply for new pump installation.</p>			
4 Front pump housing (1)	a Oil seal (7)	Remove and discard	Use seal puller

TRANSMISSION OIL PUMP REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	b. Oil seal (7)	Apply sealant to outside diameter of seal. Install with seal lip toward inside of housing. Press seal into housing until front face of seal is flush with front face of pump housing	Seal must be pressed into housing squarely using arbor press and suitable tool. Keep any sealant off sealing element and wipe off any excess sealant after seal is installed
NOTE			
Before next step lubricate all parts with transmission fluid			
5	Transmission (3)	a Front pump gasket (5)	Apply sealant and install
		b Woodruff key (6)	Install
		c Drive gear (4)	Install with one of the key slots in gear mating with key on shaft and match marks aligned

TRANSMISSION OIL PUMP REPLACEMENT INSTRUCTIONS

(Continued)



TRANSMISSION OIL PUMP REPLACEMENT INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>INSTALLATION</u>			
<p style="text-align: center;"><u>CAUTION</u></p> <p>Once pump is positioned, it must be oriented to correspond with the direction of engine rotation. For this application the portion of the pump housing marked with an arrow pointing to the right should be at top of transmission. Otherwise pump will not function when engine is started.</p> <p style="text-align: center;"><u>NOTE</u></p> <p>Cover splined portion of input shaft to protect rubber lip of pump oil seal during assembly. Use pump oil seal sleeve</p>			
6	Transmission	Front pump housing (1)	Install squarely on shaft insuring that seal is not damaged or deformed.
7	Front pump housing (1)	4 attaching bolts (2)	Install and torque to 17 - 20 ft-lb
			A slight rotation of pump will allow gear teeth to engage and pump to seat
			Use 1/2 in socket and torque wrench



TRANSMISSION ASSEMBLY REPLACEMENT INSTRUCTIONS

This task covers

- a. Removal
- b. Installation

INITIAL SETUP

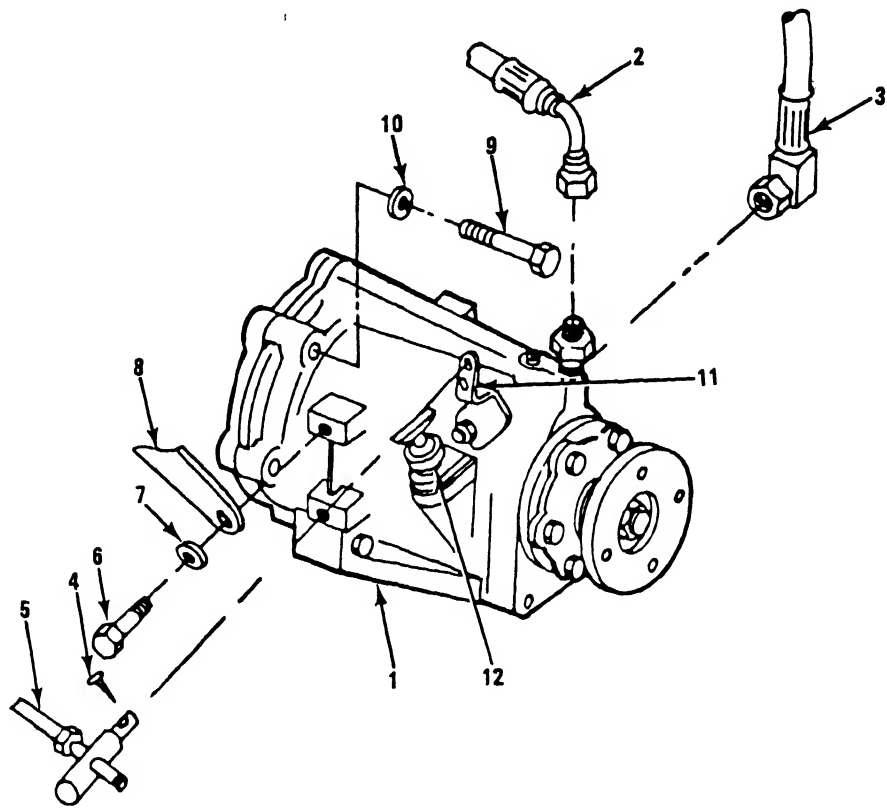
Tools	Equipment Condition	Condition Description
5/8 in socket	TM 5-1940-277-20	Engine hatch covers open
Ratchet		
6 in extension	TM 5-1940-277-20	Aft cockpit removed
11/16 in box/open wrench	TM 5-1940-277-20	Drive shaft removed
7/8 in box/open wrench	TM 5-1940-277-20	Buoyancy blocks removed
Long nose pliers		
5/8 in box/open wrench		

Materials/Parts

Transmission
 Engine oil
 Container (6 qt)
 Silicone rubber sealant

Personnel Required Two

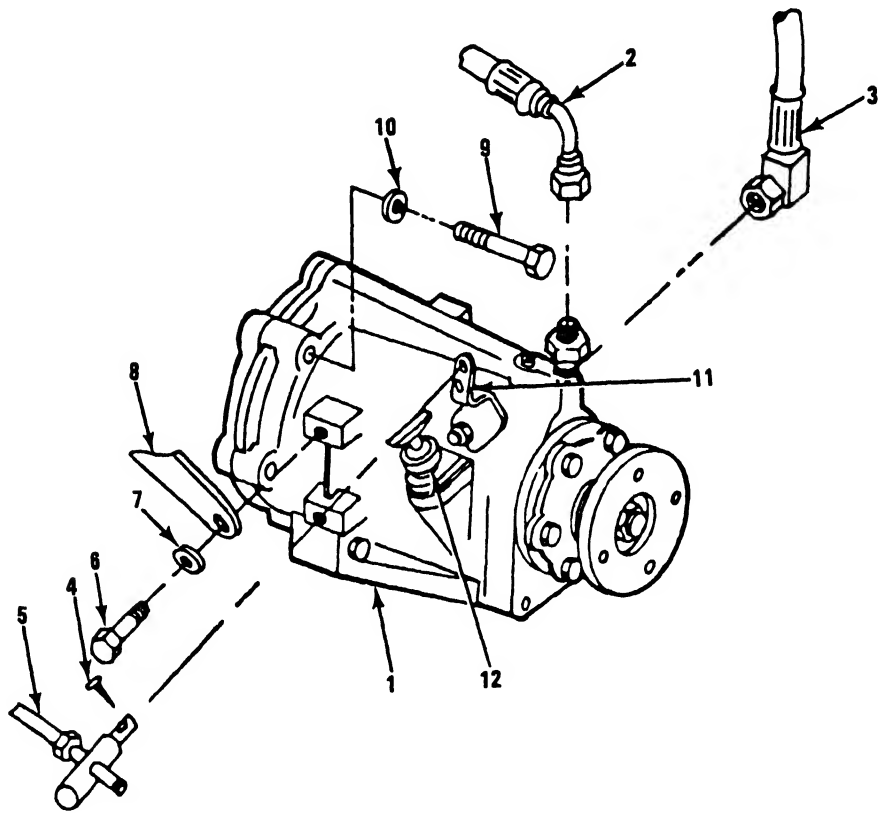
TRANSMISSION ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



TRANSMISSION ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1. Transmission (1)	a. Oil outflow line (2)	Disconnect	Use 7/8 in wrench
	b. Oil return line (3)	Disconnect	Use 7/8 in wrench Place container under connection to catch old oil
	c. Shift control cable cotter pin (4)	Disconnect by pulling cotter pin and moving cable (5) aside	Use pliers
	d. Brace cap screw (6) and washer (7)	Remove	Use 5/8 in wrench Loosen cap screw on brace connection to adapter housing so brace (8) may be moved aside
	e. 6 mounting cap screws (9) and 6 washers (10)	While supporting the rear of transmission remove	Use 5/8 in socket with extension and ratchet
	f. Transmission (1)	Carefully move transmission approximately 3 in toward rear to disengage shaft Remove transmission from boat	Use 2 persons Transmission weighs 109 pounds

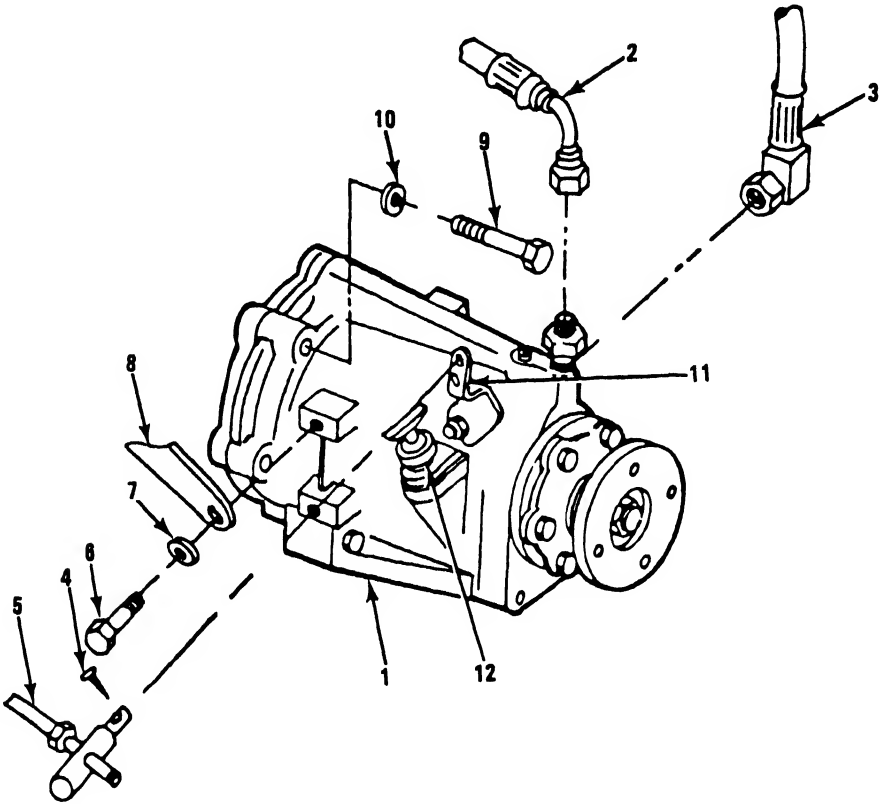
TRANSMISSION ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



TRANSMISSION ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS	
<u>INSTALLATION</u>				
2	Engine compartment	Transmission (1)	a Coat mating surface with sealant	Use silicone rubber sealant
			b Carefully lift transmission into position at rear of engine	Use 2 persons Transmission must go forward until seated against adapter housing
			c Making certain transmission is level, fit transmission spline into damper spline	
			d Support transmission	
3	Transmission (1)	a 6 mounting washers (10) and 6 cap screws (9)	Install	Support transmission at rear
		b Brace washer (7) and cap screw (6)	Install	
		c Shift control cable cotter pin (4)	Connect	Transmission shift lever (11) may be moved to a forward, neutral, or reverse position as required

TRANSMISSION ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



TRANSMISSION ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	d. Oil return line (3)	Connect.	
	e Oil outflow line (2)	Connect	
5 Transmission (1)	Dipstick (12)	a Check oil level.	
		b Fill to mark on dipstick	



HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS

This task covers

- a. Removal
- b. Installation

INITIAL SETUP

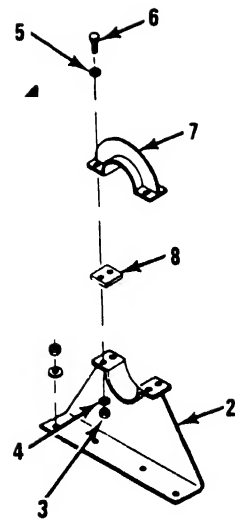
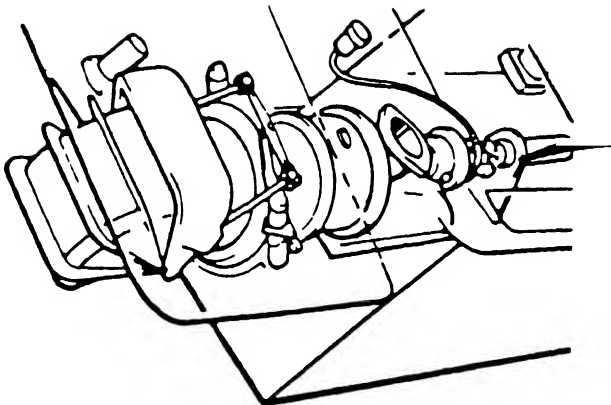
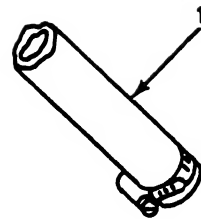
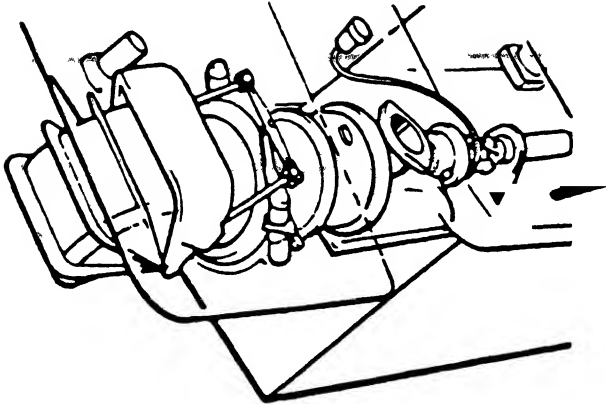
Tools	Equipment Condition	Condition Description
1/2 in combination wrench		
19 mm open end wrench		Boat out of water on grounded cradle
11/16 in open end wrench		Steering assembly removed
5/8 in open end wrench	Page 2-367	
Ratchet		
6 in extension	TM 5-1940-277-20	Aft cockpit removed
18 in extension	TM 5-1940-277-20	Access hatches open and secure
10 mm open end wrench		
19 mm socket	TM 5-1940-277-20	Drive shaft removed
10 mm socket		
Flat tip screwdriver, 6 inch		
Sling		
Wrecker		
3/8 in hex key wrench (Allen)		
Hammer, ball peen		
Drift pin		

Materials/Parts

Oil
Grease
Intake gasket
Gasket adhesive - nonhardening
Small container

Personnel Required Three, wrecker operator will only operate wrecker

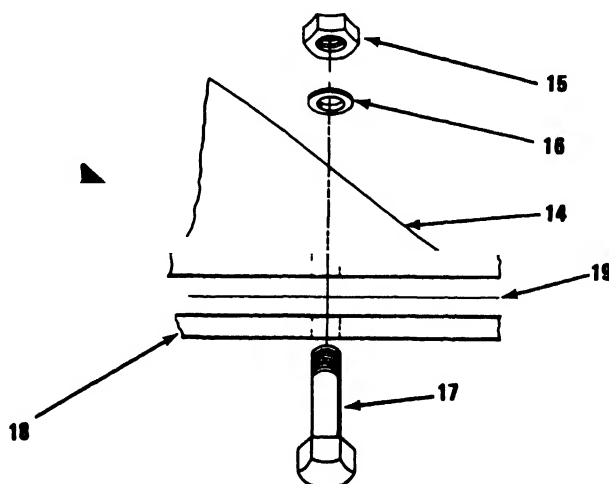
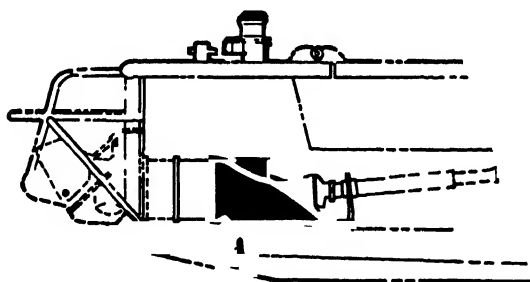
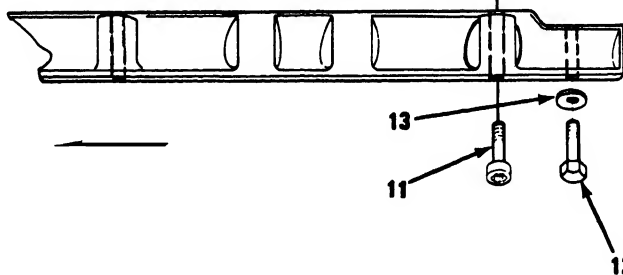
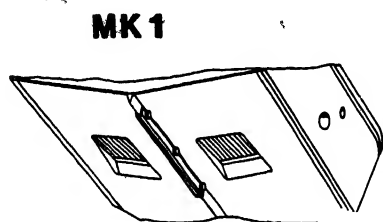
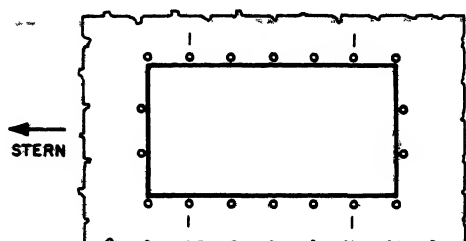
HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
NOTE			
Before performing next step get a small container to hold oil in reservoir.			
1. Hydrojet compartment	Oil pipe (1)	Loosen clamp. Disconnect hose and drain oil.	Use screwdriver. Drain oil into container.
2 Drive shaft guard (2)	4 nuts (3), 4 washers (4), 4 bolts (5), cap (7) and 2 spacers (8)	Remove bolts, nuts, washers and cap and set aside.	Use 10 mm wrench and 10 mm socket with ratchet.

HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)



HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

WARNING

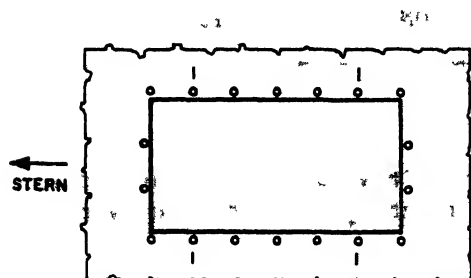
Exercise care in removing intake grille. It weighs 30 pounds and retainer may separate from grille when mounting bolts are removed. Injury to personnel will result.

NOTE

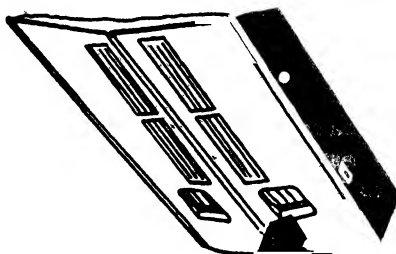
Before next step, check bolt installation diagram for four unmarked bolts. These are bolts removed in next step.

3.	Hull, aft underside	4 nuts (9), 4 washers (10), and 4 socket head bolts (11) securing intake grille	Remove nuts, washers and bolts. When last bolt is removed grille will drop free.	Three persons required, one inboard, two outboard. Use 3/8 in hex key wrench (Allen) outboard and 14 mm socket, ratchet and extension in- board
4	Hydrojet intake case (14)	a 2 cap screws (12) and 2 washers (13) securing aft end of intake case	Remove from underneath boat	Use 19 mm socket and ratchet

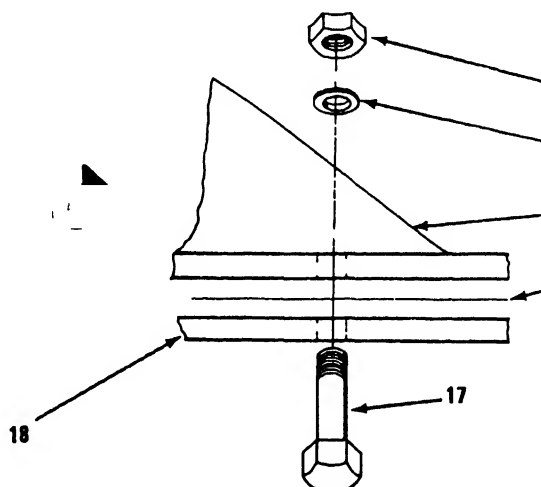
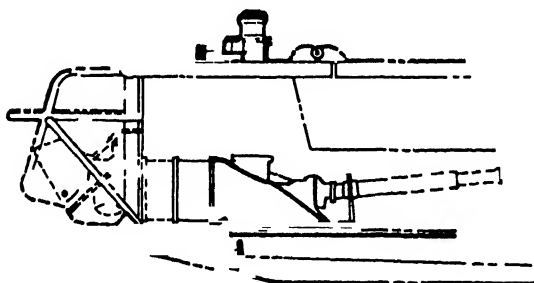
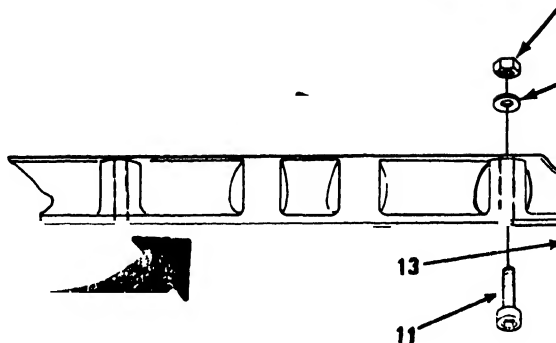
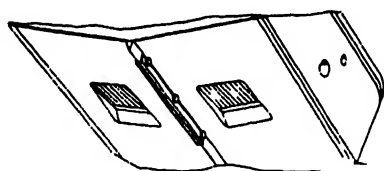
HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)



MK2



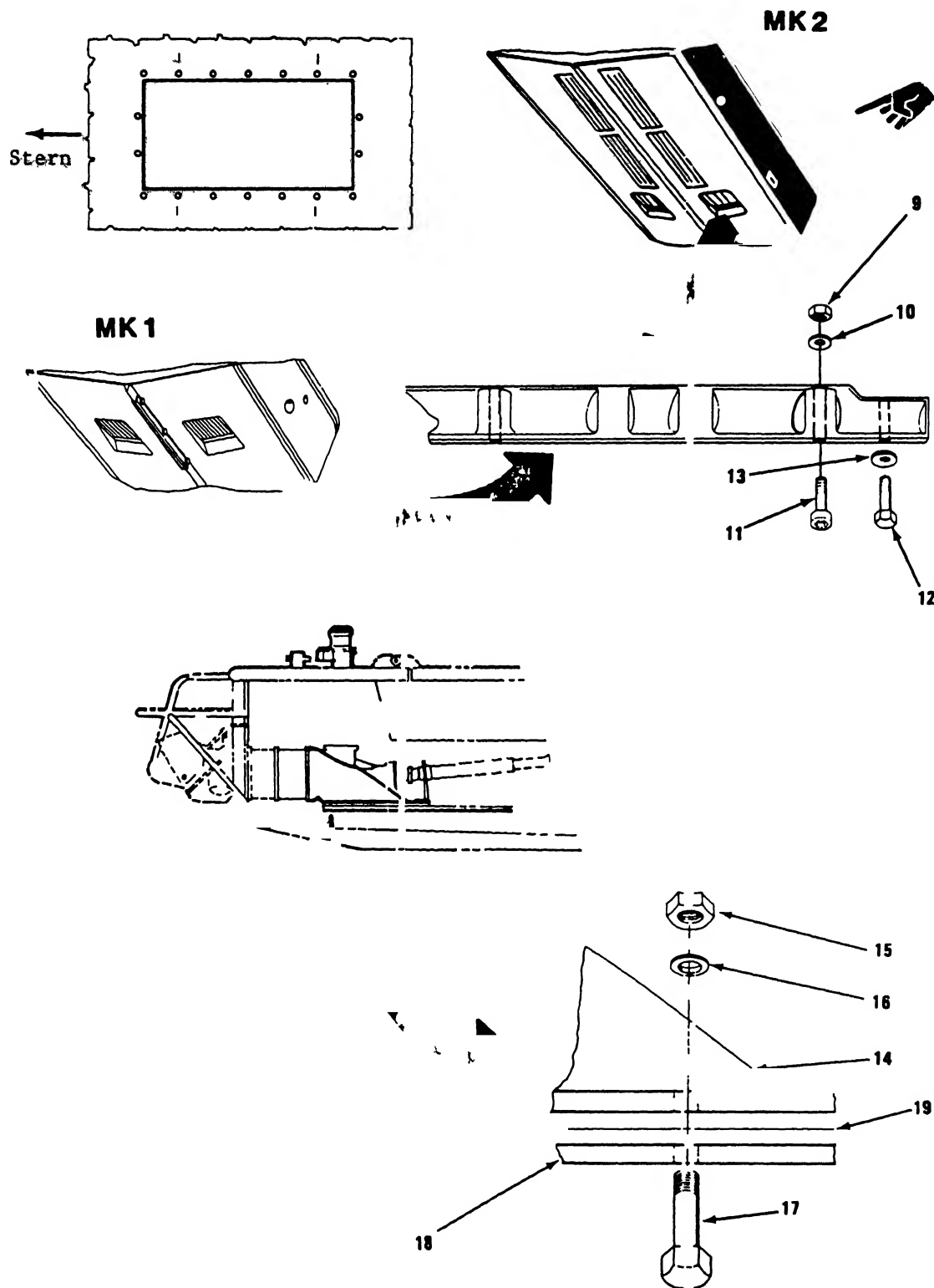
MK1



~~INSTRUCTIONS FOR THE REMOVAL OF THE HYDROJET ASSEMBLY~~
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	b. 12 nuts (15), 12 washers (16), and 12 bolts (17) retaining intake case	Remove nuts, washers and bolts which pass through hull (18), this frees intake case.	Two persons needed Use 19 mm wrench out- board and 19 mm socket, ratchet and 18 in exten- sion inboard. This also frees drive shaft guard bottom section (2) which must be set aside. It may be necessary to tap bolts through hull, use hammer and drift.
	c Sling	Attach to hydro- jet unit and to lifting device Attach sling to intake case only	
5 Hydrojet compartment	a Hydrojet assembly	Carefully lift assembly out of compartment Position as required	Guide unit out of compartment carefully to prevent damage
	b Intake gasket (19)	Remove and discard	

HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)



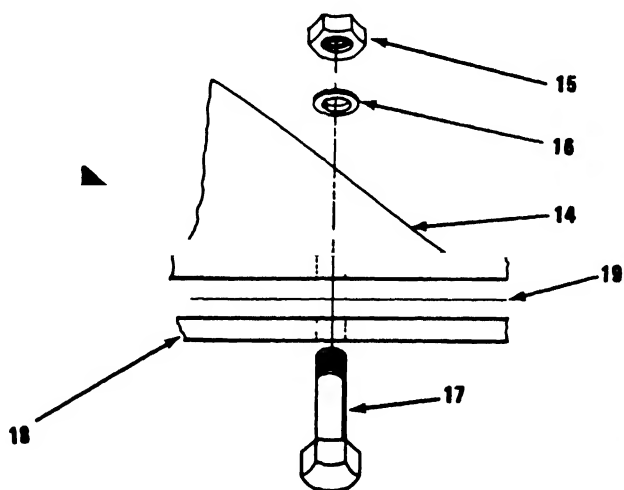
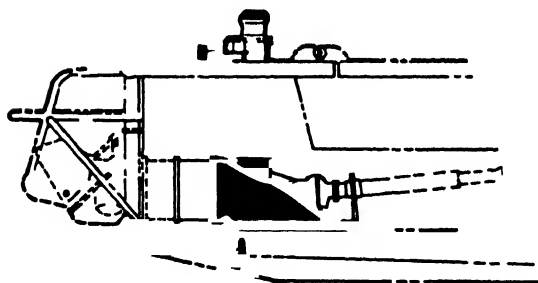
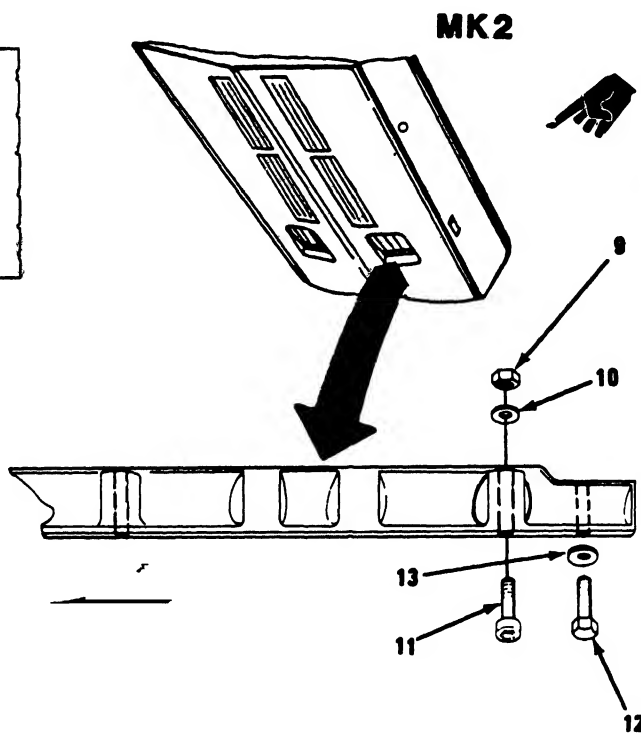
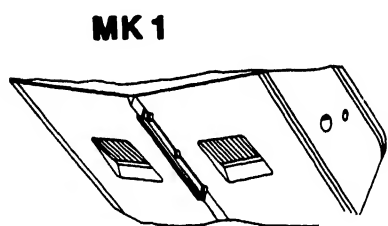
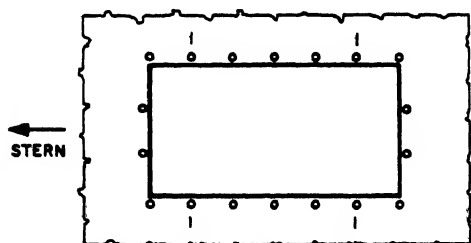
HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>INSTALLATION</u>			
<p style="text-align: center;">NOTE</p> <p>If assembly has rear reaction case attached, it must be removed. To remove case, remove eight cap screws, nuts and washers and then remove case. Case may be attached to steering assembly. Refer to steering assembly removal procedure.</p>			
6. Hydrojet compartment	Intake gasket (19)	Coat one side of gasket with adhesive and stick into position on hull interior.	Make sure bolt holes are aligned.
7. Hydrojet assembly	Sling	Attach to intake case and to lifting device.	
8. Hydrojet compartment	Hydrojet assembly	Carefully lift assembly and position into compartment, aligning bolt holes.	Use drift pins through corner bolt holes to assist in alignment. Be careful not to displace the intake gasket (19) and to align bolt holes as unit is positioned.

NOTE

Before going to next step look at diagram. Note order in which mounting bolts are installed.

HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)



HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

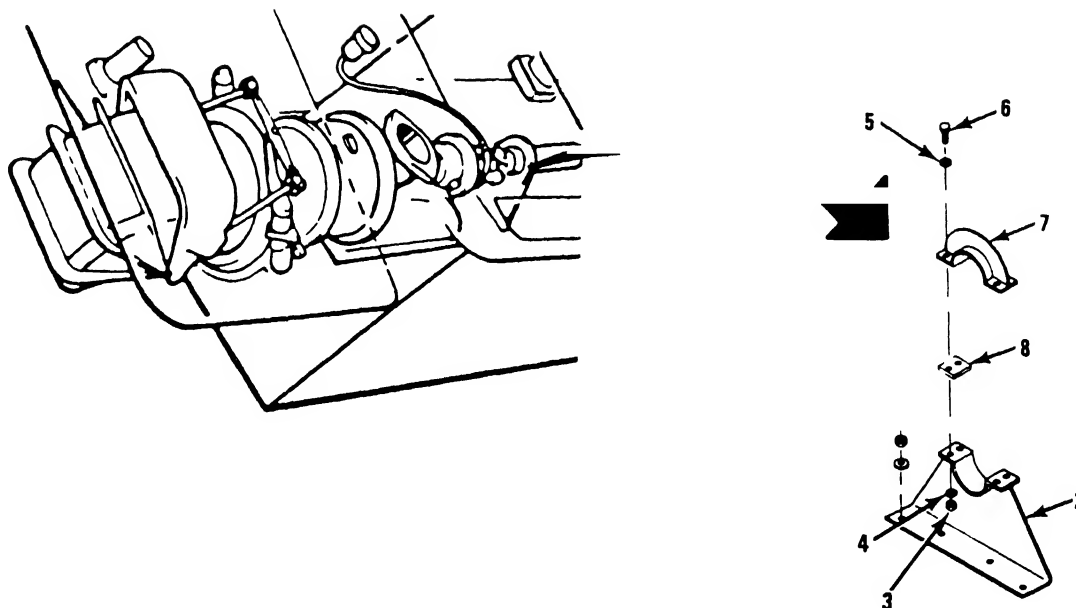
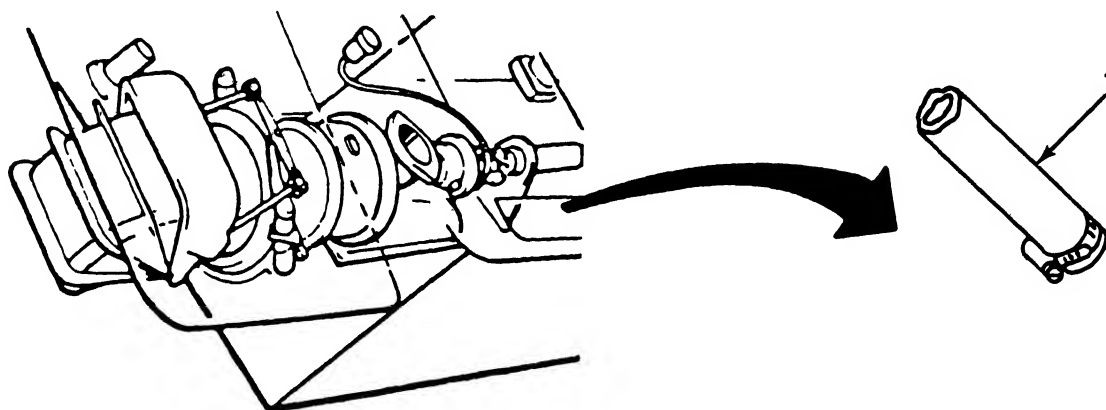
LOCATION	ITEM	ACTION	REMARKS
9 Hydrojet intake case (14)	a Drive shaft guard bottom section (2)	Position across forward edge of intake case	Check the positioning of guard on other intake case to double check for correct positioning
	b 2 cap washers (13) and 2 cap screws (12)	Install cap screws and washers in positions noted as 2 on the installation diagram	Use 19 mm socket and ratchet
	c 12 mounting bolts (17), 12 washers (16) and 12 nuts (15)	Install bolts, nuts and washers noted as 1 on the installation diagram	Two persons needed Use 19 mm wrench outboard and 19 mm socket, ratchet and 18 in extension inboard

NOTE

Before proceeding to next step, make sure intake grille and retainer are assembled properly and mounting bolts are handy Two persons outboard are required

10 Hull aft underside	Intake grille, 4 socket head bolts (11), 4 washers (10), and 4 nuts (9)	a Position grille into hull opening with scoop portion of retainer toward bow of boat	One person must be inboard during installation
		b Secure with bolts, washers and nuts	

HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)



HYDROJET ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
11 Drive shaft guard (2)	Drive shaft guard spacers (8), cap (7), 4 washers (4), 2 bolts (5), and 2 nuts (3)	Install cap and secure	Use 10 mm wrench and 10 mm socket with ratchet
12. Hydrojet compartment	a. Oil pipe (1)	Connect and tighten clamp	Use screwdriver
	b Oil reservoir	Fill with oil	See LO 5-1940-277-12

NOTE

FOLLOW ON MAINTENANCE PROCEDURE Do steering assembly installation procedure (page 2-367)



STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS

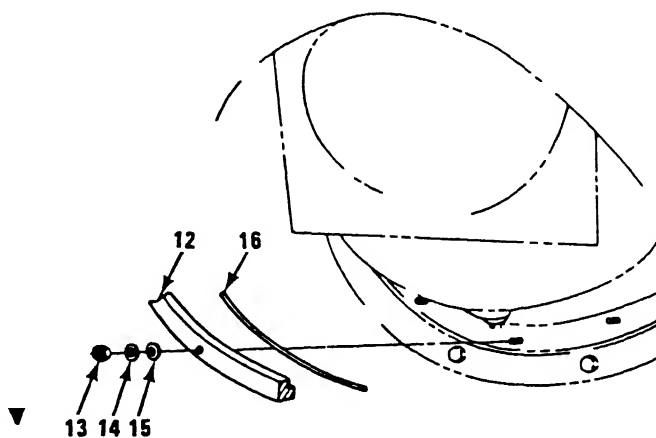
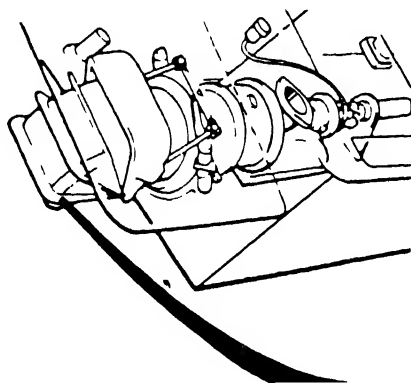
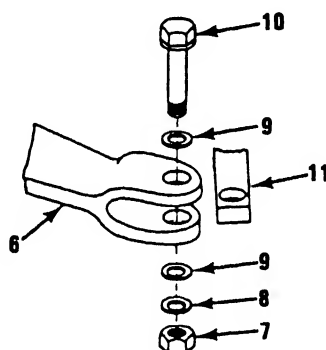
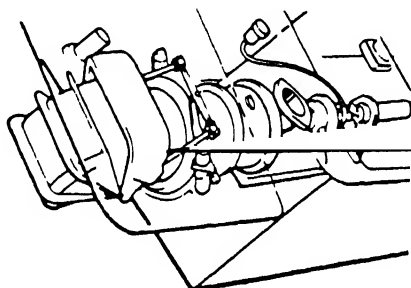
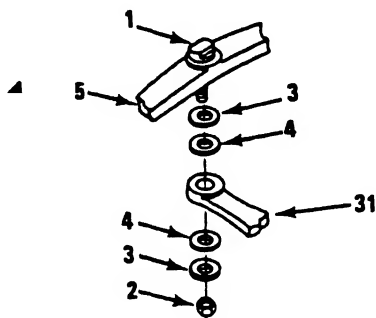
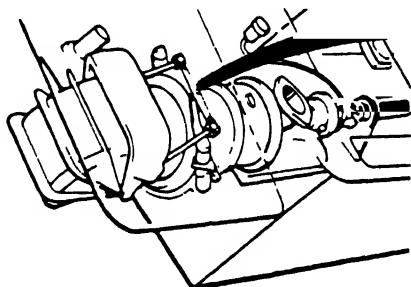
This task covers

- a. Removal
- b. Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
19 mm open end wrench		Boat out of water on grounded cradle
19 mm socket		
17 mm box/open wrench		
Ratchet		
6 in extension		
17 mm socket, 3/8 in drive		
14 mm box/open wrench (2 each)		
8 mm hex key wrench (Allen)		
17 mm box/open wrench		
Pinch, bar		
Transmission jack		
Materials/Parts		
Reaction case gasket		
Grease (GAA)		
Cord, 10 foot		
Rubber seal ring		
Rope		
Personnel Required	Three	

STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

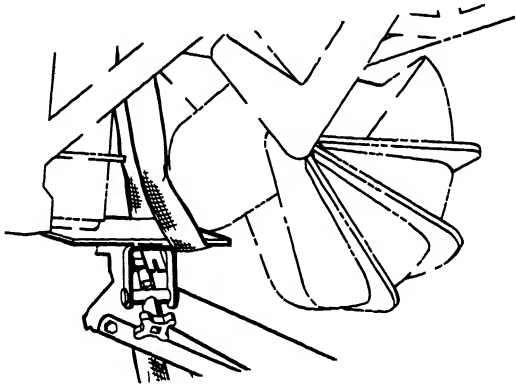


STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS

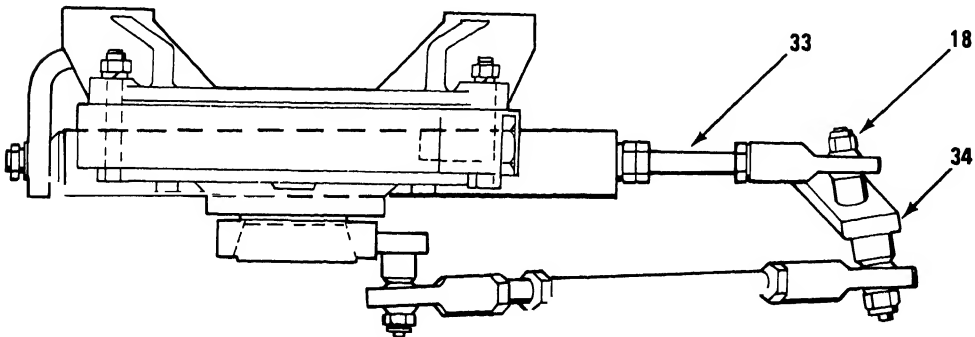
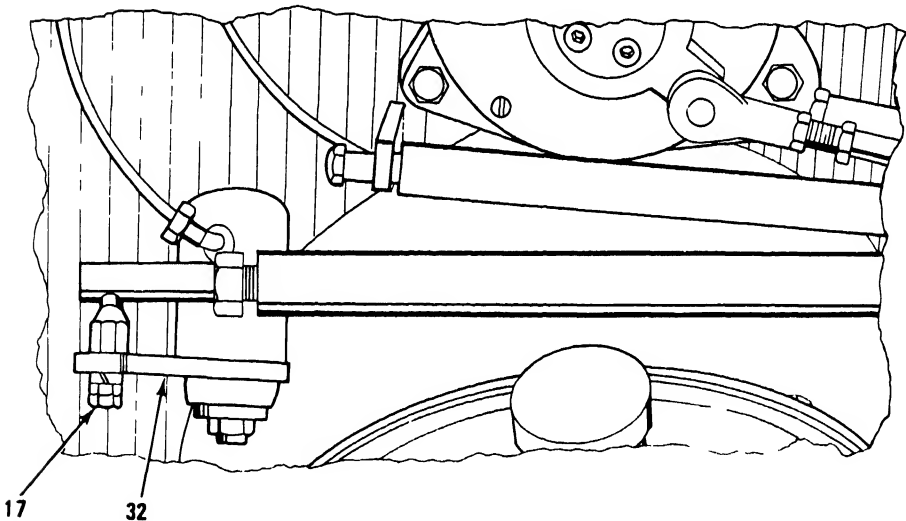
(Continued)

LOCATION	ITEM	ACTION	REMARKS	
NOTE				
Before doing first step tie scoop in place by passing light cord around scoop fin and in between scoop fin and cover and tying off				
<u>REMOVAL</u>				
1	Reverse control pivot (1)	a Nut (2), steel washer (3), tufnol washer (4)	Remove	Use 19 mm open end wrench and 19 mm socket with ratchet
		b Reverse balance lever (5)	Disconnect from outboard reverse lever (31)	Retain two washers that separate reverse balance lever (5) from reverse lever (31)
2	Outboard steer lever (6)	Nut (7), steel washer (8), tufnol washer (9), bolt (10), and steering link (11)	Remove nut, washers, and bolt and move link aside	Use 17 mm wrench and 17 mm socket with ratchet
3	Transom sealing flange (12)	a 12 nuts (13), 12 steel washers (14), 12 tufnol washers (15)	Remove Move flange out of position	Use 14 mm wrench
		b Transom rubber seal ring (16)	Ease out of position	Use hands
NOTE				
Before going to next step position transmission jack under steering assembly and raise jack until it is in contact with the lower pivot bracket Secure steering assembly to jack using rope				

STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



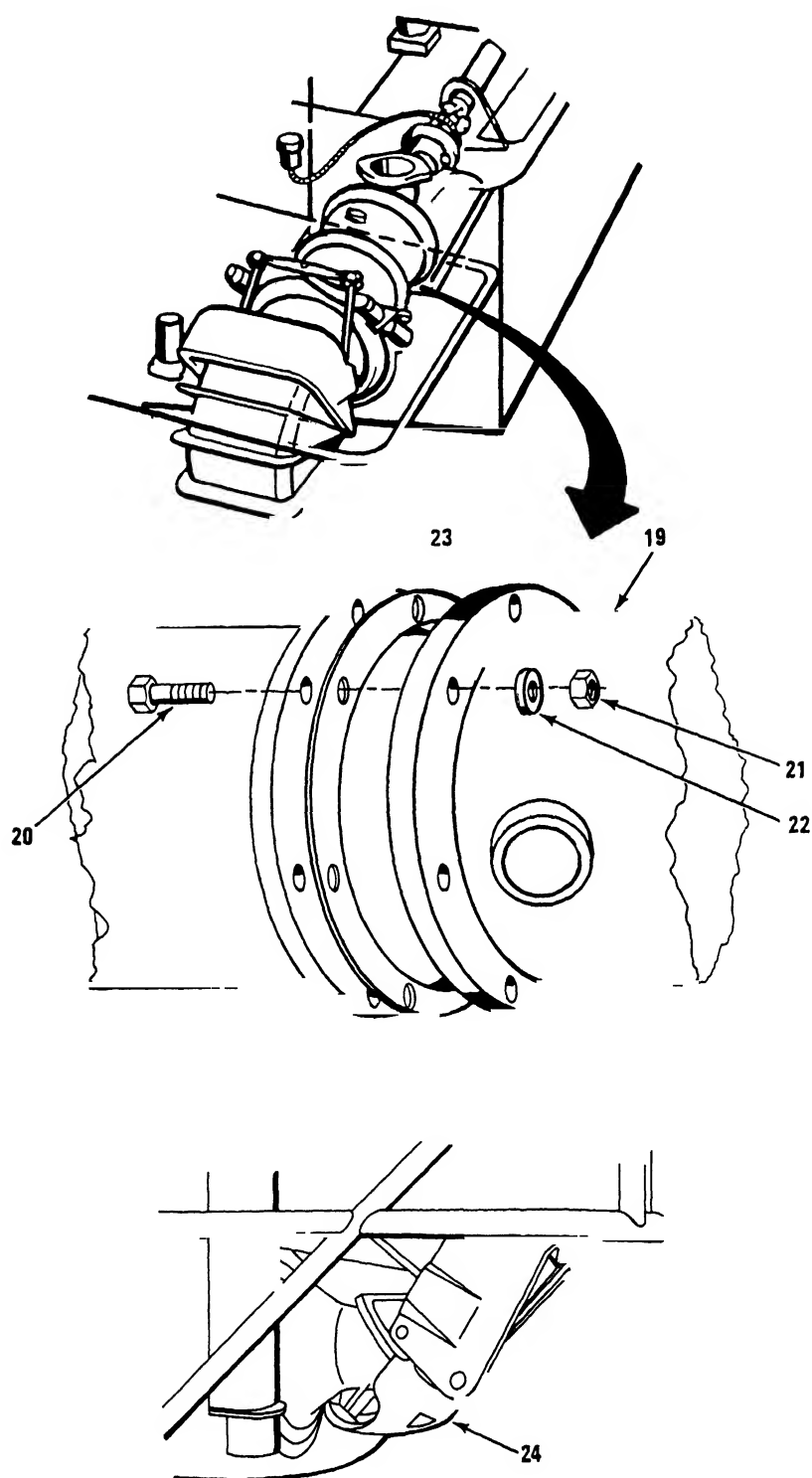
JACK PLACEMENT



STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
NOTE			
Perform step 4 if removing starboard steering assembly and step 5 if removing port steering assembly. Scoop control in full reverse.			
4. Starboard hydrojet compartment	Tie bar securing nut (17)	Remove nut and lift tie bar up from inboard steering lever (32).	Use two 14 mm wrenches.
5. Port hydrojet compartment	Guide tube rod securing nut (18)	Remove nut. Lift guide tube rod (33) off connecting stud on inboard scoop control lever (34).	Use 14 mm wrench Rod is under spring pressure and may have to be pulled toward center of boat to ease off stud Once disconnected let rod out slowly Assembly may now be removed by pulling out

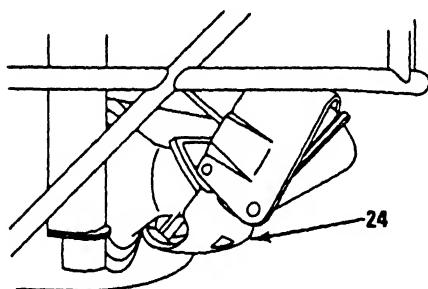
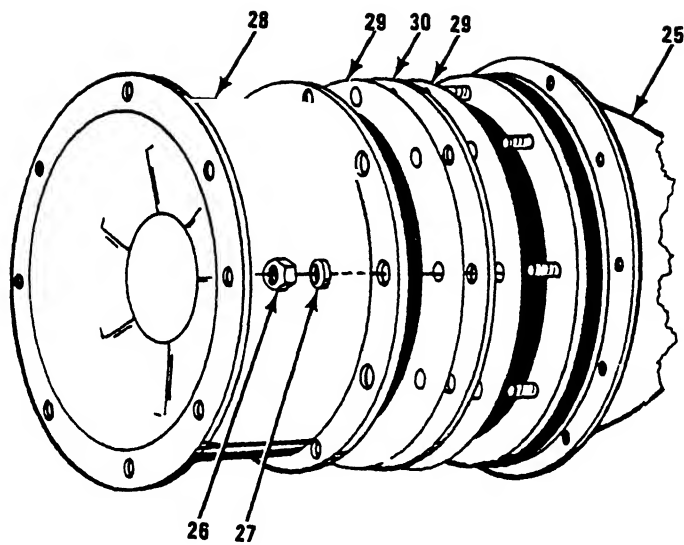
STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
6. Front reaction case (19)	8 front to rear reaction case connecting bolts (20), 8 nuts (21), 8 washers (22)	Remove	Use 8 mm hex key wrench (Allen) and 14 mm wrench
<p style="text-align: center;">NOTE</p> <p>During the next step keep steering assembly level as it is withdrawn to avoid damage to the rear impeller</p>			
7 Boat stern	Steering assembly (24)	Pull transmission jack and steering assembly carefully away from the stern of boat until clear of divers platform. When clear of platform it can be picked up and carried to work area.	Two persons required outboard, one inboard. Keep unit level to clear opening.
8 Front reaction case (19)	Gasket (23)	Remove and discard	

STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



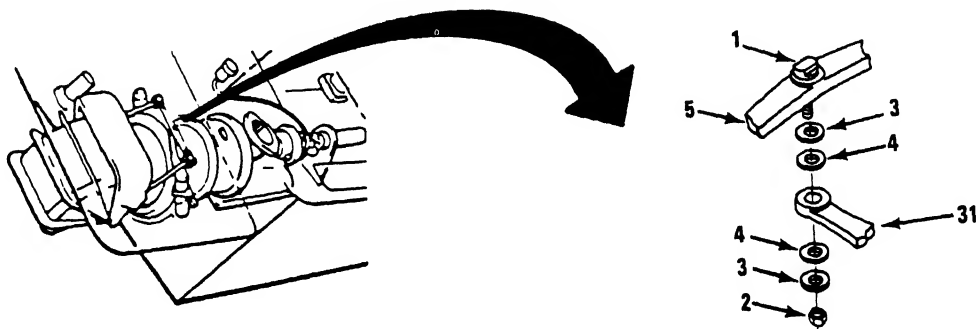
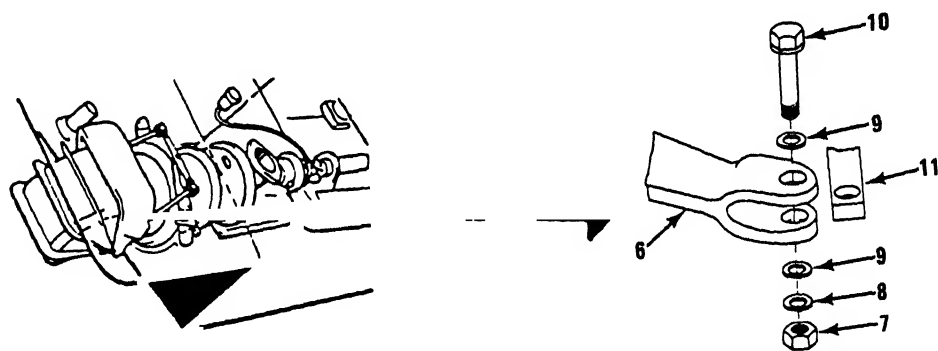
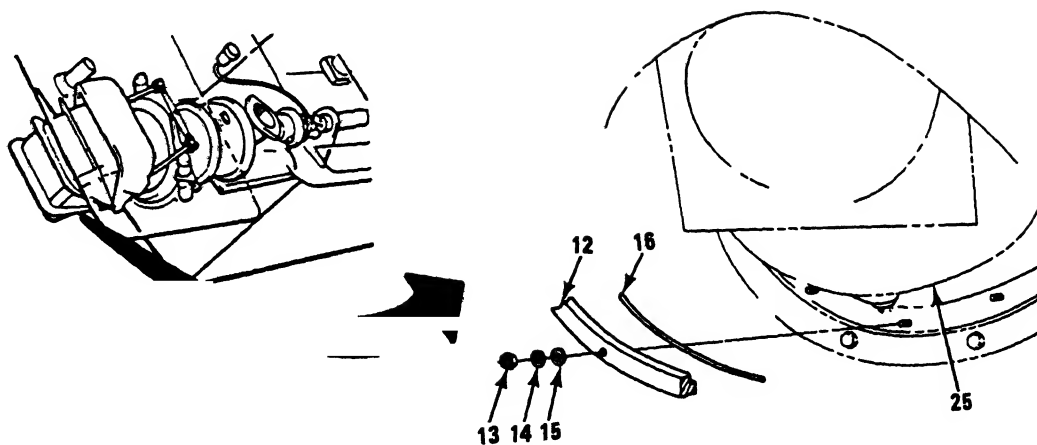
STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
9	Tail pipe (25)	a. 8 rear reaction case connecting nuts (26) and 8 washers (27)	Remove. Use 14 mm wrench
		b. Rear reaction case (28)	Remove and set aside.
		c. Gasket (29), insulating ring (30), gasket (29)	a. Remove.
			b. Discard gasket
			c. Retain insulating ring

INSTALLATION

10	Tail pipe (25)	a. Reaction case gaskets (29), insulating ring (30)	Smear gaskets with grease, place on each side of ring and fit on tail pipe studs	
		b. Rear reaction case (28)	Fit to tail pipe	
		c. 8 washers (27) and 8 nuts (26)	Install and tighten	Use 14 mm wrench

STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)



STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

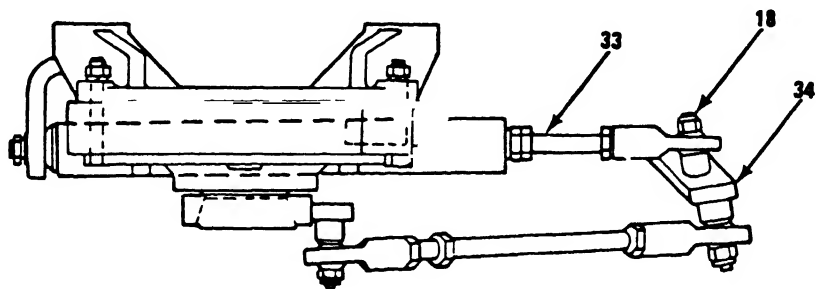
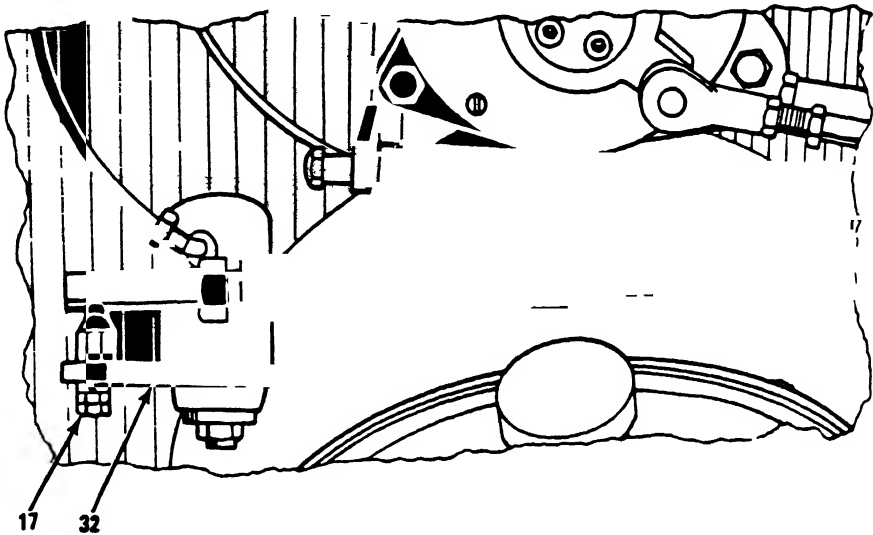
LOCATION	ITEM	ACTION	REMARKS
15. Tail pipe (25)	a Transom rubber seal ring (16)	Smear with grease and gently press into position	Use hands Jack may be removed for better accessibility
	b. Transom sealing ring (12), 12 tuf-nol washers (15), 12 steel washers (14), 12 nuts (13)	Place ring into position and install washers and nuts	Use 14 mm wrench

NOTE

It may be necessary to loosen pump bolts to align transom seal "O" ring

16 Outboard steering lever (6)	a Pivot bolt (10), washer (9), steering link (11), tufnol washer (9), steel washer (8), nut (7)	Install bolt with washer on to connect outboard steering lever (6) and steering link Install washers and nut and tighten	Use 17 mm wrench and 17 mm socket with ratchet
	b Reverse balance lever (5)	Position on top of outboard reverse lever (31) making certain one steel (3) and one tufnol (4) washer are between the levers	
	c Reverse control pivot (1)	Install tufnol washer (4), steel washer (3) and nut (2).	Use 19 mm open end wrench and 19 mm socket with ratchet

STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



STEERING ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
NOTE			
Perform step 17 if starboard steering assembly was removed and step 18 if port steering assembly was removed Scoop control should be in full reverse			
17 Starboard hydrojet compartment	Tie bar securing nut (17)	Fit tie bar to inboard steering lever and install securing nut (17)	Use two 14 mm wrenches
18 Port hydrojet compartment	Guide tube rod securing nut (18)	Seat end of guide tube in hole on rotary control Pry pivot end of rod toward boat center until connection can be made to stud on inboard scoop control lever Install nut when rod seated on stud	Use 14 mm wrench and pinch bar to pry tube guide rod into position
NOTE			
FOLLOW ON MAINTENANCE PROCEDURE (TM 5-1940-277-20) Do scoop and steering adjustment			



STEERING ASSEMBLY REPAIR INSTRUCTIONS - REVERSE BALANCE LEVER REPLACEMENT

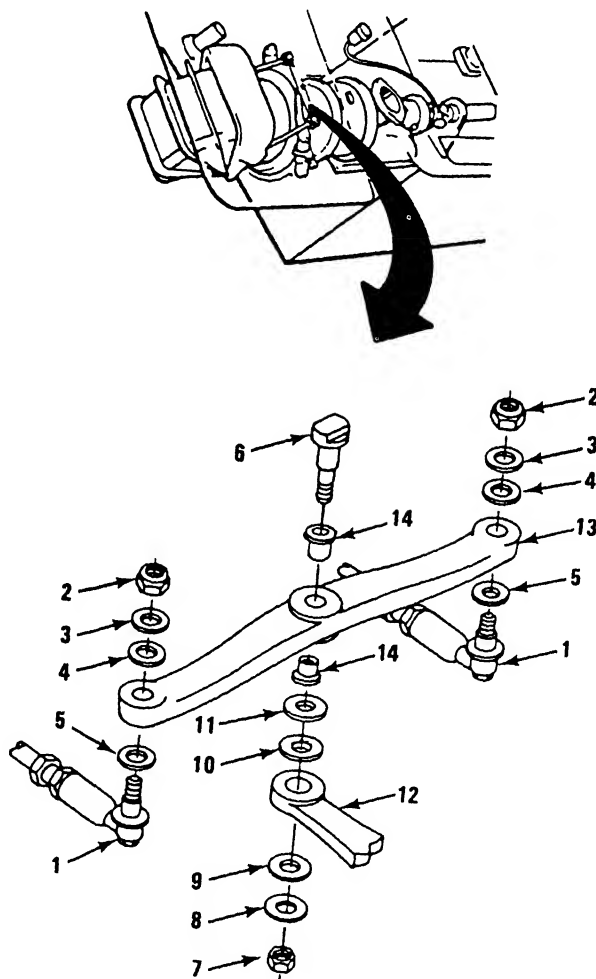
This task covers

- a. Removal
- b. Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
19 mm box/open wrench (2)		Boat out of water on grounded cradle.
17 mm box/open wrench		
13 mm box/open wrench		
Pliers		
Punch		
Hammer		
Vise		
Materials/Parts		
Reverse balance lever		

STEERING ASSEMBLY REPAIR INSTRUCTIONS - REVERSE BALANCE LEVER REPLACEMENT
(Continued)



STEERING ASSEMBLY REPAIR INSTRUCTIONS - REVERSE BALANCE LEVER REPLACEMENT (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL

NOTE

If the reverse balance lever is broken the scoop will be secured in some manner or will be hanging free. In either case movement of scoop will not occur when anything is disconnected. If the lever is not broken but only cracked the first step below will free scoop to drop to lowest point. No damage will occur but you should be prepared for this to happen.

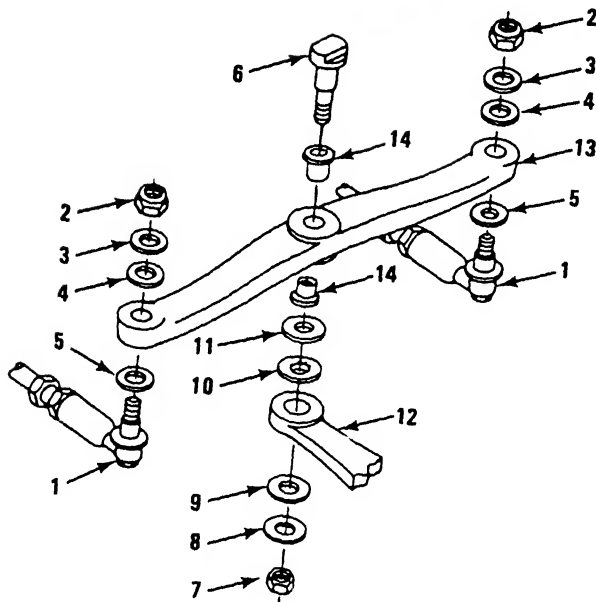
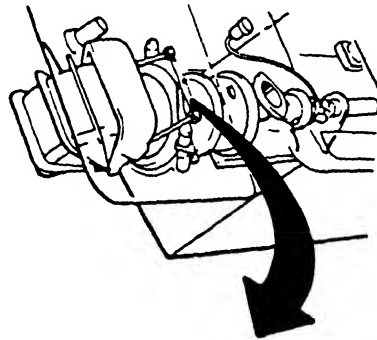
- | | | | |
|-------------------------|---|---|---|
| 1. Ball joint pivot (1) | Nut (2), steel washer (3) and tufnol washer (4) | Remove larger of two nuts and washers on each pivot and separate pivot from reverse balance lever (13) (Scoop control rod stays attached to pivot) | Use 17 mm and 13 mm wrenches. There are two pivots, one each end of reverse balance lever (13). There will be a tufnol washer (5) on pivot when it separates. Do not lose it. |
|-------------------------|---|---|---|

NOTE

Next step is subject to equipment condition. If reverse balance lever is broken the reverse control pivot will be attached only to outboard reverse balance lever. Before removing nut check for all components [pivot (6), two flanged bushings (14), two steel washers (11, 8), two tufnol washers (10, 9), and nut (7)].

- | | | | |
|-----------------------------|---|--------|------------------------|
| 2 Reverse control pivot (6) | a Nut (7), steel washer (8) and tufnol washer (9) | Remove | Use two 19 mm wrenches |
|-----------------------------|---|--------|------------------------|

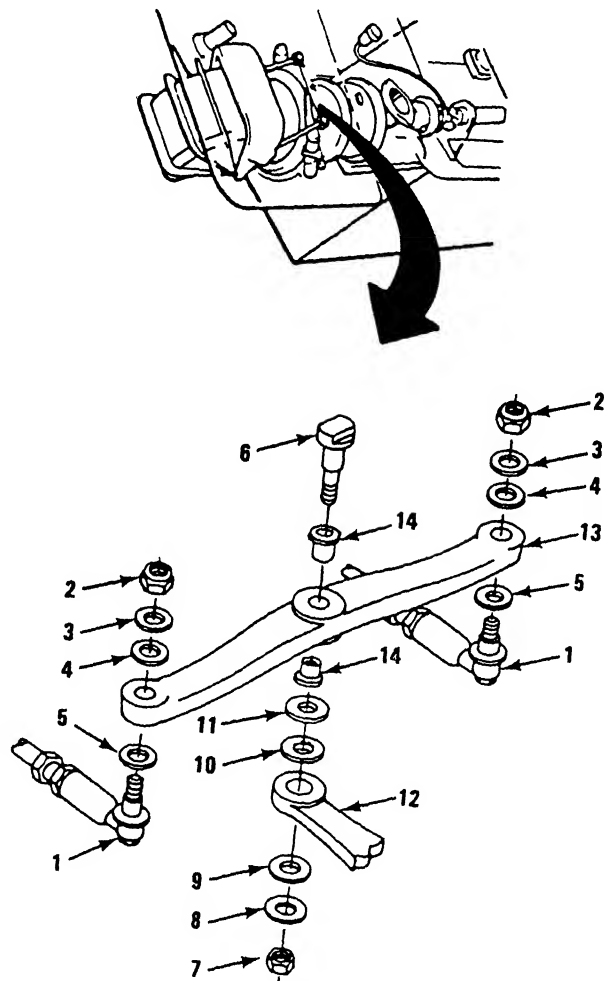
STEERING ASSEMBLY REPAIR INSTRUCTIONS - REVERSE BALANCE LEVER REPLACEMENT (Continued)



ING ASSEMBLY REPAIR INSTRUCTIONS - REVERSE BALANCE LEVER REPLACEMENT inued)

ION	ITEM	ACTION	REMARKS
	b. Reverse control pivot (6)	Withdraw from outboard reverse lever (13). As pivot clears outboard reverse balance lever one steel washer (10) and one tufnol washer (11) placed between the reverse balance lever (13) and outboard lever (12) will be freed. Do not lose them.	Pliers may be required to get pivot out.
Reverse balance lever (13)	a. Reverse control pivot (6)	Remove	
	b. 2 flanged bushings (14)	Remove and retain	Use punch and hammer as required. Be careful not to damage bushing
<u>LLATION</u>			
Reverse balance lever (13)	a. 2 flanged bushings (14)	Install one each side of center hole	Use vise to squeeze bushing into position
	b. 2 ball joint pivots (1) and 2 tufnol washers (5)	Install one each end of reverse balance lever.	
Ball joint pivot (1)	Tufnol washer (4), steel washer (3) and nut (2)	Install and tighten.	Use 17 mm and 13 mm wrenches.

STEERING ASSEMBLY REPAIR INSTRUCTIONS - REVERSE BALANCE LEVER REPLACEMENT
(Continued)



NG ASSEMBLY REPAIR INSTRUCTIONS - REVERSE BALANCE LEVER REPLACEMENT
nued)

ON	ITEM	ACTION	REMARKS
verse balance ver (13)	Reverse control pivot (6)	Install pivot Then fit one steel and one tufnol washer onto pivot and hold in position while connecting reverse balance lever/pivot assembly to out- board reverse balance lever (13).	
verse control vot (6)	Tufnol washer (9), steel washer (8) and nut (7) washer (8), nut (7)	Install and tighten	Use two 19 mm wrenches After tightening, operate scoop control on opera- tor's console If movement is hard loosen nut on reverse con- trol pivot (6) slightly and see if this eases operation of scoop control

NOTF

LOW ON MAINTENANCE PROCEDURE Do scoop adjustment check and
justment procedure as required (TM 5-1940-277-20)



TEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP CONTROL ROD REPLACEMENT

his task covers

- . Removal
- . Installation

CAUTION

This assembly contains left and right hand threads. Threads can be damaged if over stressed.

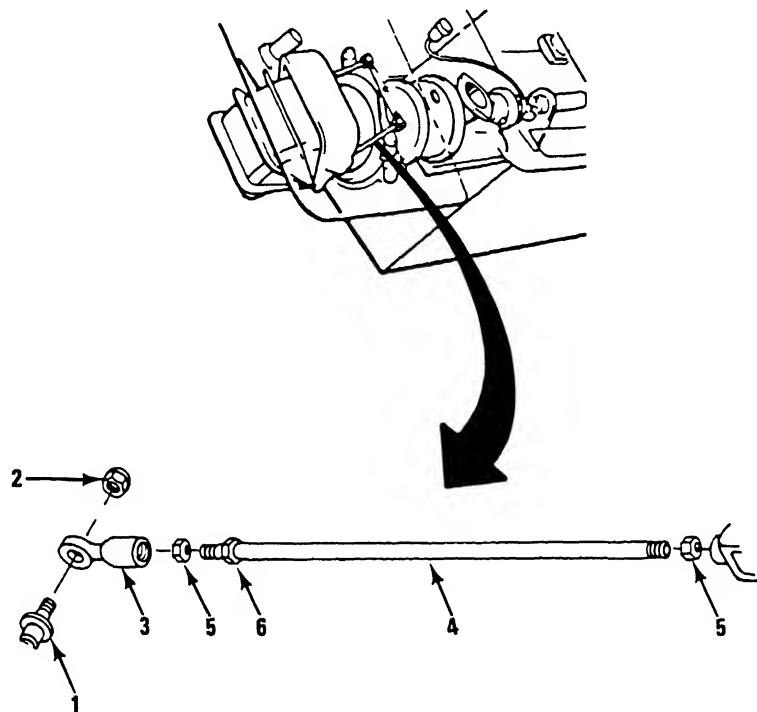
INITIAL SETUP

ools	Equipment Condition	Condition Description
7 mm open end wrench		Boat out of water.
3 mm open end wrench		

aterials/Parts

coop control rod

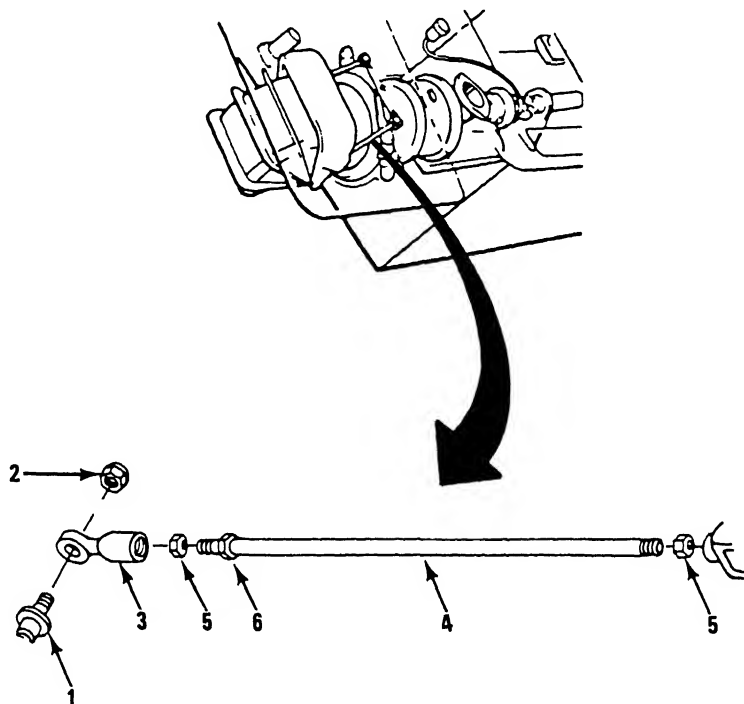
STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP CONTROL ROD REPLACEMENT
(Continued)



STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP CONTROL ROD REPLACEMENT (Continued)

LOCATION	ITEM	ACTION	REMARKS	
<u>REMOVAL</u>				
1	Ball joint pivot (1)	a. Nut (2)	Remove the smaller nut on pivot. It is on ball end.	Use 13 mm and 17 mm wrenches.
		b. Ball joint (3)	Slip joint off pivot.	
2.	Scoop control rod (4)	a. 2 lock nuts (5)	Loosen nuts on both ends of rod.	Use 17 mm wrench. Nut on end next to fixed nut has left hand threads.
		b. Fixed nut (6)	Use to unscrew rod from fork	
		c. Ball joint (3)	Unscrew from rod	Has left hand thread
		d Lock nut (5)	Remove from rod	
<u>INSTALLATION</u>				
3.	Scoop control rod (4)	a 2 lock nuts (5)	Screw nuts on both ends of rod.	One nut has left hand thread If it does not fit easily on one end try other.
		b. Ball joint (3)	Screw on rod.	Put on end with fixed nut
		c. Scoop control rod (4)	Screw rod into fork end.	Use 17 mm wrench

STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP CONTROL ROD REPLACEMENT
(Continued)



STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP CONTROL ROD REPLACEMENT
(Continued)

LOCATION	ITEM	ACTION	REMARKS
4. Ball joint pivot (1)	a. Ball joint (3)	Fit joint over pivot.	
	b. Nut (2)	Install and tighten	Use 13 mm and 17 mm wrenches

STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP REPLACEMENT

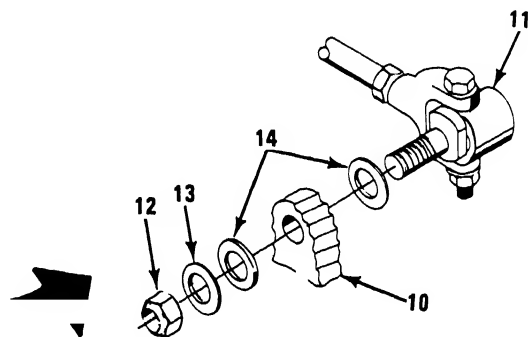
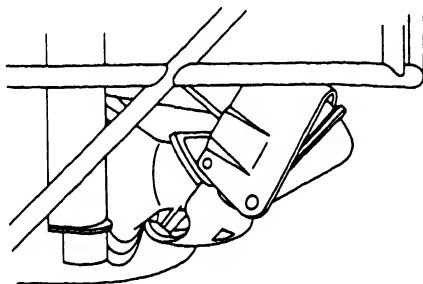
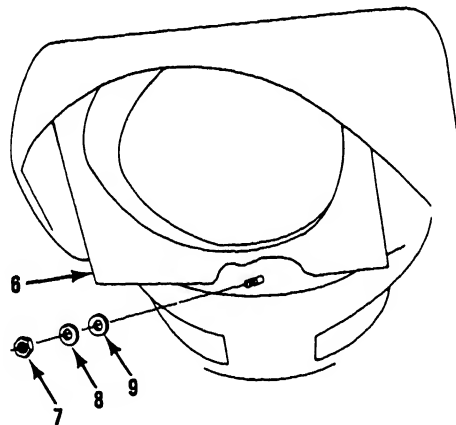
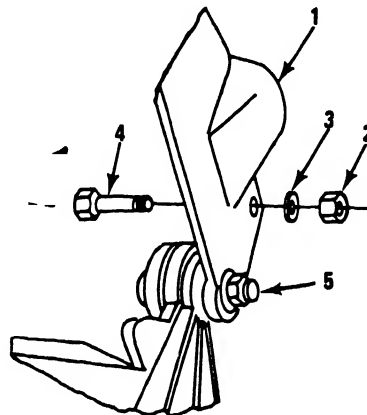
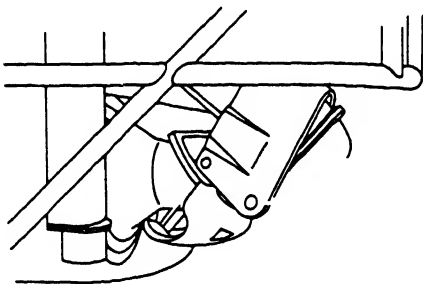
This task covers

- a. Removal
- b. Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
19 mm open/box wrench		Boat out of water on grounded cradle
19 mm socket		
Ratchet		
17 mm open/box wrench		
17 mm socket		
Hammer		
Punch		
Torque wrench		
Vise		
Materials/Parts		
Scoop		
Personnel Required	Two	

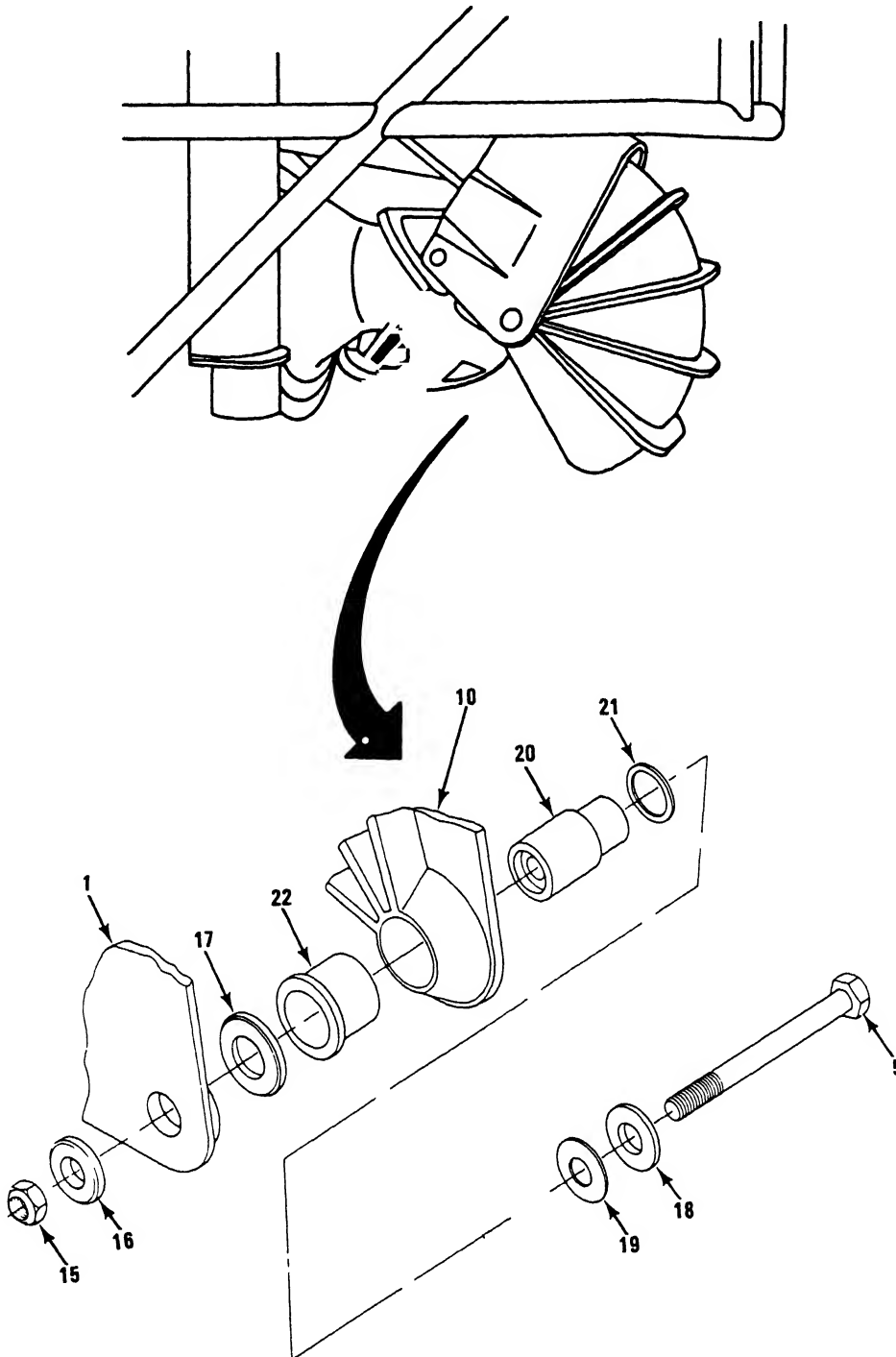
STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP REPLACEMENT
(Continued)



STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP REPLACEMENT (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1. Cover (1)	a. Upper mounting nut (2), washer (3) and bolt (4)	Remove.	Use 17 mm wrench and 17 mm socket with ratchet.
	b. Scoop retaining and lower mounting bolt (5)	Loosen and swing cover rearward to gain access to top of tail pipe	Use 19 mm wrench and 19 mm socket with ratchet.
NOTE			
Scoop control in full reverse for next step.			
2 Jet nozzle (6)	a 3 nuts (7), 3 steel washers (8) and 3 tufnol washers (9)	Remove one on bottom and one each side with access from top.	Use 17 mm wrench
	b Jet nozzle (6)	Pull free from tail pipe	Use hammer to free nozzle.
3 Scoop (10)	Control pivot (11), nut (12), steel washers (13) and tufnol washer (14)	Remove nut and washer and withdraw pivot from scoop (one each side)	Use 19 mm wrench and 19 mm socket with ratchet. This will free scoop to rotate around its mounting bolt. No damage will result.

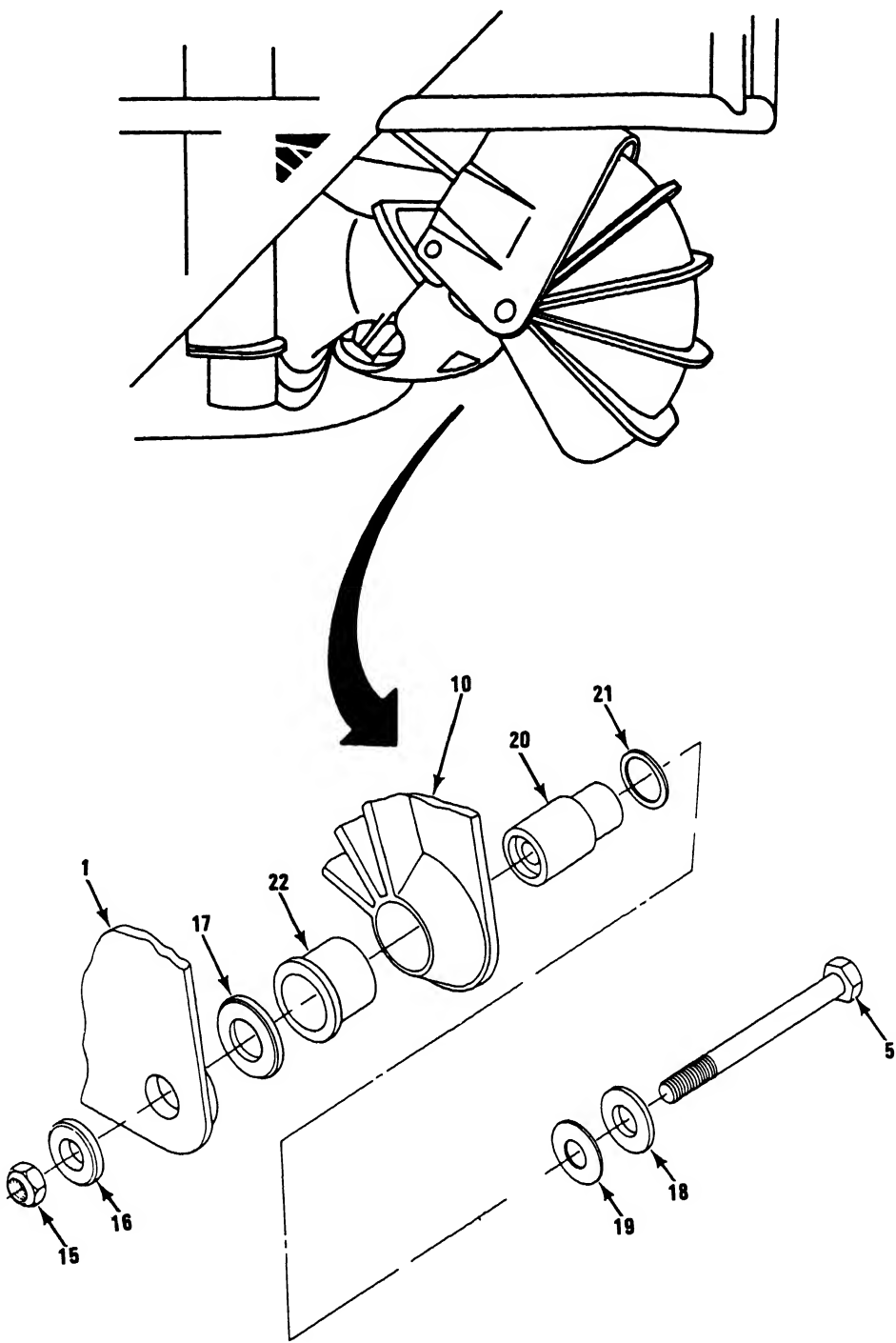
STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP REPLACEMENT
(Continued)



STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP REPLACEMENT (Continued)

LOCATION	ITEM	ACTION	REMARKS
4. Cover (1)	a. Scoop retaining and lower mounting bolt (5)	Remove nut (15) and washer (16). Drive bolt back until it clears cover mounting sleeve.	Use 19 mm wrench, 19 mm socket, and ratchet. Use hammer and punch as required. Use one person each side to prevent binding and damage.
	b. Cover (1)	Remove and lay aside.	
5. Scoop (10)	a. Scoop retaining and lower cover mounting bolt (5)	Remove bolt.	This will free a large plain washer (17), small plain washer (18) and small insulating washer (19).
	b. Trunion (20)	Push from inside of tail pipe mounting toward outside of scoop to free scoop. The large insulating washer (21) will be freed and drop out as trunion is pushed back through scoop. Do not lose it.	There is one each side. When second trunion is pushed clear of tail pipe mounting the scoop will be free for removal. Use one person each side to prevent binding and damage.
	c. Scoop (10)	Remove.	
<p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">Do not damage surface of the trunion.</p>			

STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP REPLACEMENT
(Continued)



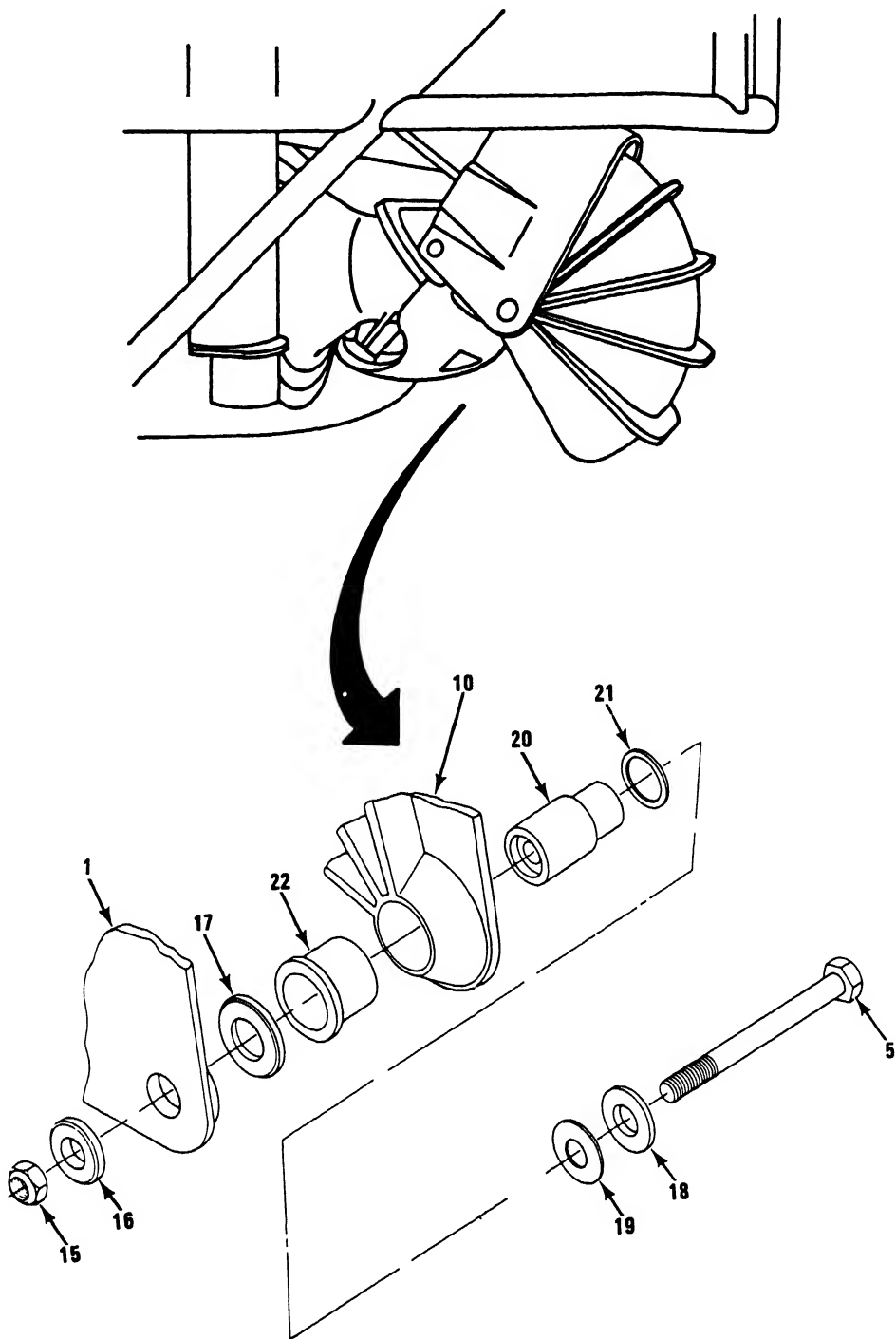
STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP REPLACEMENT (Continued)

LOCATION	ITEM	ACTION	REMARKS
	d. Trunion (20)	Pull out of scoop.	
<p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">Do not damage inner bore of bushing.</p>			
	e. Long flanged bushing (22)	Remove from scoop and retain.	Use hammer and punch if required.

INSTALLATION

6	Scoop (10)	a Long flanged bushing (22)	Install in scoop.	Use vise to press in if necessary
		b Trunion (20)	Install in bushing and push in until just clear of scoop inside surface	
		c Large insulating washer (21)	Fit over the part of trunion sticking through scoop inside surface	
		d Scoop (10)	Fit into mounting position	Use one person each side to control and prevent damage

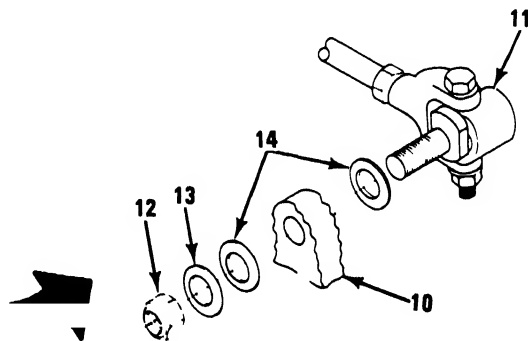
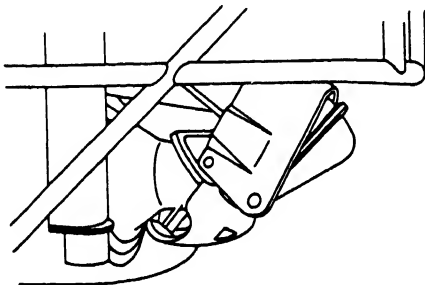
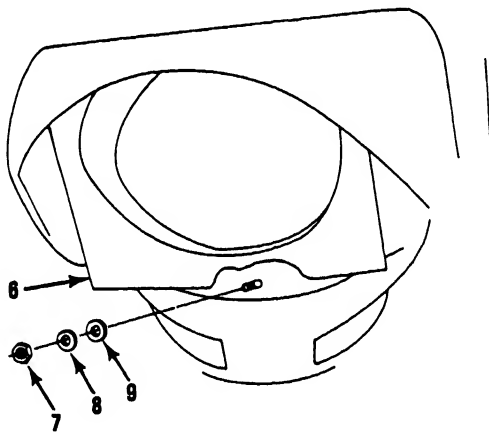
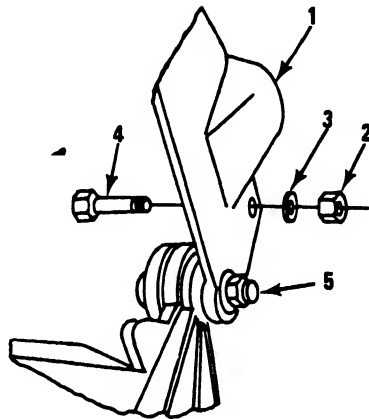
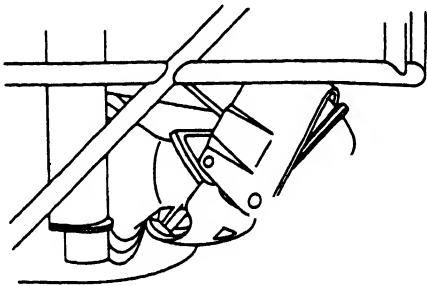
STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP REPLACEMENT
(Continued)



STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP REPLACEMENT (Continued)

LOCATION	ITEM	ACTION	REMARKS
	e. Trunion (20)	Push in until seated. Smaller portion of trunion fits into mounting hole in tail pipe casting.	This secures scoop to tail pipe but the scoop can still swing freely.
	f. Scoop retaining and lower cover mounting bolts (5)	Partially install bolt with small plain washer (18) and small insulating washer (19) on bolt. Install from inside through trunion. Push through until 2 - 3 threads are exposed outside face of trunion.	
	g. Large plain washer (17)	Place on exposed threads of bolt.	
7. Cover (1)	a. Cover (1)	Position and push mounting bolt through sleeve.	Use one person each side. Make sure large plain washer stays in place.
	b. Scoop retaining and cover lower mounting bolt (5)	Install small plain washer (16) and nut (15).	Tighten finger tight. This will hold assembly together until final positioning is completed.

STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP REPLACEMENT
(Continued)



STEERING ASSEMBLY REPAIR INSTRUCTIONS - SCOOP REPLACEMENT (Continued)

LOCATION	ITEM	ACTION	REMARKS
8. Tail pipe	Jet nozzle (6)	Fit into position on tail pipe	
9. Jet nozzle (6)	Tufnol washer (9), steel washer (8) and nut (7)	Install three locations and tighten	Use 17 mm wrench.
10. Scoop (10)	Control pivot (11), tufnol washer (14), steel washer (13), nut (12)	Install pivot through scoop, secure with washer and nut and tighten	Use 19 mm wrench, 19 mm socket and ratchet
11 Cover (1)	a Upper mounting bolt (2), washer (4) and nut (3)	Rotate cover into position, install bolt, secure with washer and nut and tighten	Use 19 mm wrench, 19 mm socket and ratchet

NOTE

Before next step move scoop control to full forward

b	Scoop retaining and cover lower mounting bolt (5)	Torque to 40 ft-lb	Use torque wrench
---	---	--------------------	-------------------

NOTE

FOLLOW ON MAINTENANCE PROCEDURE Check scoop adjustment (TM 5-1940-277-20)

STEERING ASSEMBLY REPAIR INSTRUCTIONS - ROTARY CONTROL ASSEMBLY

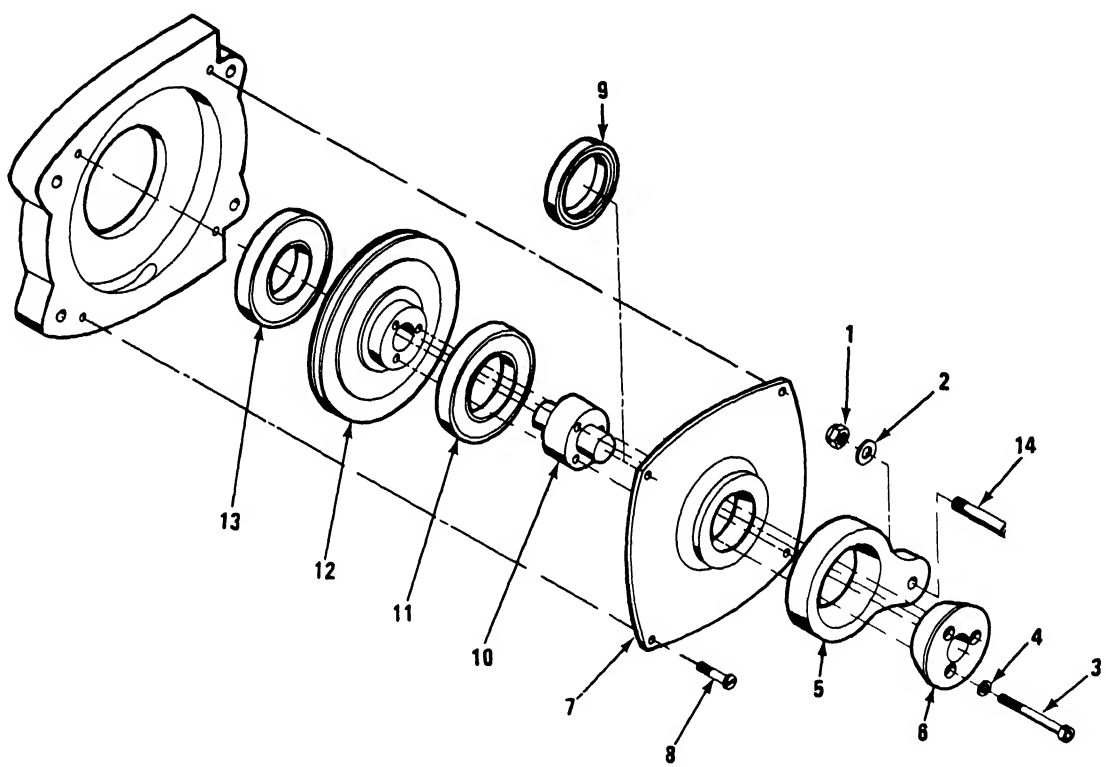
This task covers

- a Disassembly
- b Inspection
- c Repair
- d. Assembly

INITIAL SETUP

Tools	Equipment Condition	Condition Description
7/32 in hex key wrench (Allen)	TM 5-1940-277-20	Hydrojet hatches opened and secured
17 mm open/box wrench	TM 5-1940-277-20	Steering cable removed
17 mm open end wrench		
13 mm open/box wrench		
13 mm socket		
Ratchet		
Flat tip screwdriver, 6 inch		
Materials/Parts		
Shaft seal		
Bearings		
Seal sleeve		
Grease		

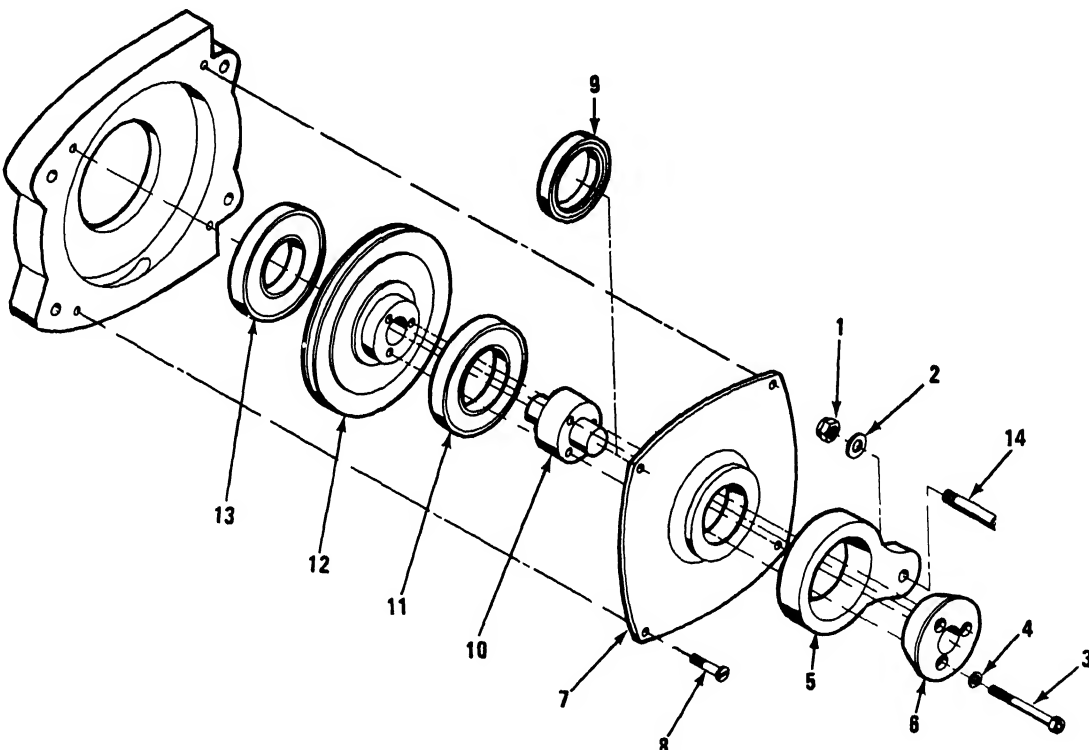
STEERING ASSEMBLY REPAIR - ROTARY CONTROL ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued)



STEERING ASSEMBLY REPAIR INSTRUCTIONS - ROTARY CONTROL ASSEMBLY
(Continued)

LOCATION	ITEM	ACTION	REMARKS	
<u>DISASSEMBLY</u>				
1	Rotary control assembly	a Ball joint pivot nut (1) and washer (2)	Remove Take pivot (14) out of crank (5)	Use two 17 mm wrenches.
		b 3 socket head screws (3) and 3 washers (4)	Remove and retain	Use 7/32 in hex key wrench (Allen)
		c Crank (5)	Remove crank and cone (6) as unit	Use hands
		d Cover (7)	Remove four screws (8) and put cover aside	Use screwdriver
		e Seal (9)	Pull out of cover and discard	Use seal puller
		f Seal sleeve (10)	Pull out and retain	Make sure bearing (11) does not pull out with sleeve
		g Front bearing (11)	Remove and retain	
		h Cable wheel (12)	Remove and retain	Cable wheel is packed in grease. Rear bearing may stick to wheel
		i Rear bearing (13)	Remove	

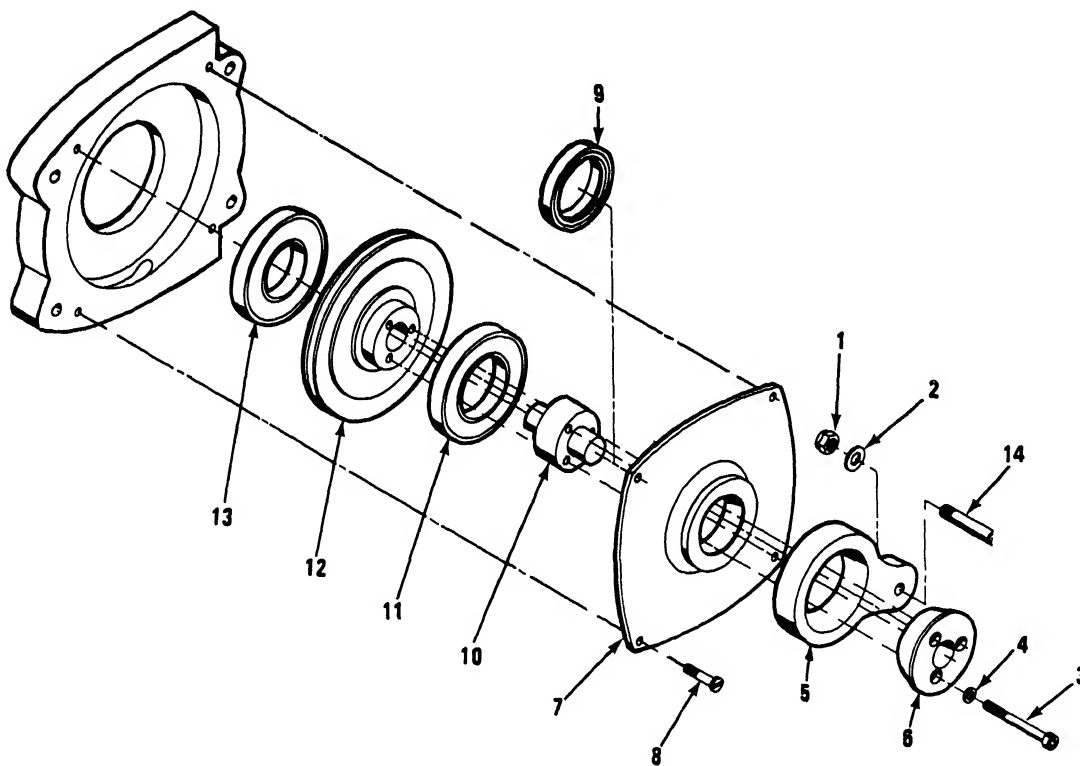
STEERING ASSEMBLY REPAIR - ROTARY CONTROL ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued)



STEERING ASSEMBLY REPAIR INSTRUCTIONS - ROTARY CONTROL ASSEMBLY (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>INSPECTION</u>			
NOTE			
Clean all components before inspecting			
2	Bearings (11 and 13)	a Check for Chips, Cracks or Discoloration b Replace defective or discolored bearings	
3	Cone (6), crank (5), cable wheel (12) and seal sleeve (10)	a Inspect all components for Cracks or Breaks b Replace defective parts	
<u>ASSEMBLY</u>			
NOTE			
Smear all parts with grease before assembly			
4	Rotary control assembly	a Rear bearing (13) b Cable wheel (12)	Fit to rear side of cable wheel (12) Fit cable wheel and bearing (13) into body Rear bearing to remain in position while wheel fitted

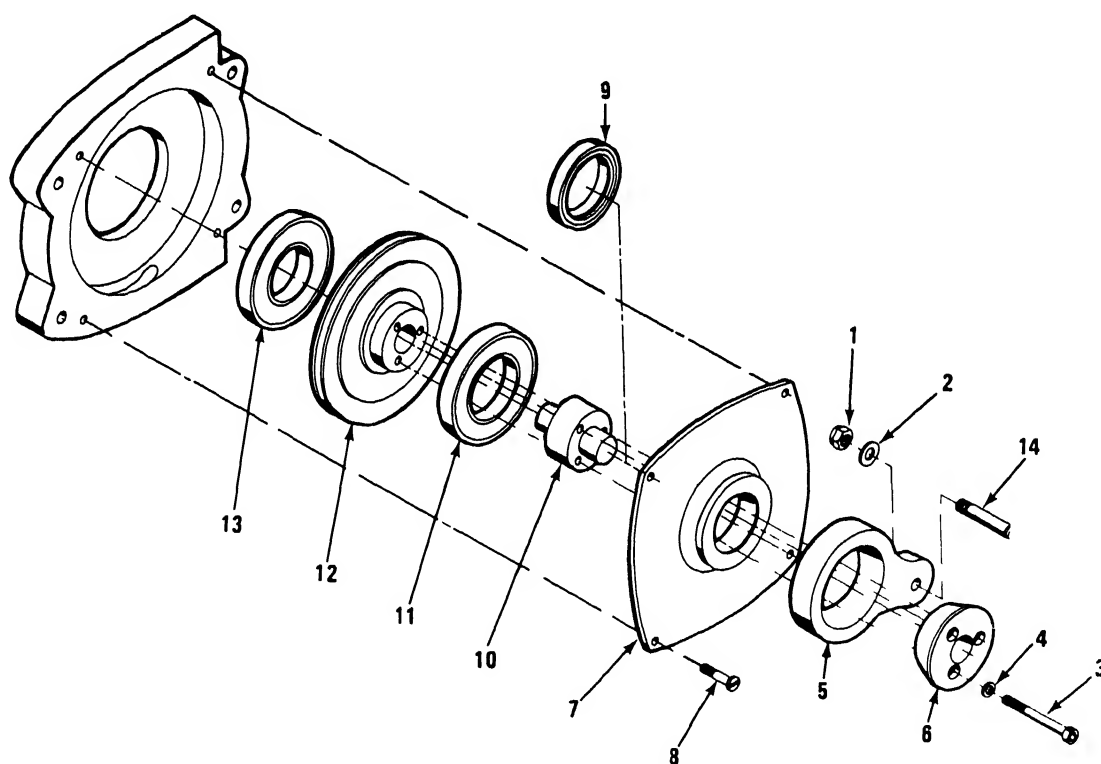
STEERING ASSEMBLY REPAIR - ROTARY CONTROL ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued)



NG ASSEMBLY REPAIR INSTRUCTIONS - ROTARY CONTROL ASSEMBLY (continued)

ON	ITEM	ACTION	REMARKS
	c. Front bearing (11)	Fit into position on front of cable wheel (12).	
	d. Seal sleeve (10)	Fit into position with bolt holes alined with those in cable wheel.	
	e. Seal (9)	Fit into front cover.	
	f. Cover (7)	Carefully slide cover over seal sleeves and bearings. Move assembly into position and secure cover with four screws (8)	Use screwdriver. The cover positions the assembly components. Care should be taken to see that cover is properly positioned and fitted
	g. Crank (5) and cone (6)	Fit crank over cone and position this subassembly, alining bolt holes in cone with those in seal sleeve (10)	
	h. 3 socket head screws (3) with washers (4)	Install	Tighten finger tight
	i. Ball joint washer (2) and nut (1)	Fit pivot (14) to crank (5) and install washer and nut.	Use 17 mm wrench

STEERING ASSEMBLY REPAIR - ROTARY CONTROL ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued)



STEERING ASSEMBLY REPAIR INSTRUCTIONS - ROTARY CONTROL ASSEMBLY
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	j. 3 socket head screws (3)	Tighten evenly.	Use 7/32 in hex key wrench (Allen) Three socket head screws secure assembly together
NOTE			
FOLLOW ON MAINTENANCE PROCEDURE Do scoop adjustment check (reference TM 5-1940-277-20)			



ROTARY CONTROL ASSEMBLY REPLACEMENT INSTRUCTIONS

This task covers

- a Removal
- b Installation

INITIAL SETUP

Tools

17 mm open/box wrench
17 mm open end wrench
1/2 in open/box wrench
1/2 in socket
Ratchet

Equipment Condition

TM 5-1940-277-20
TM 5-1940-277-20

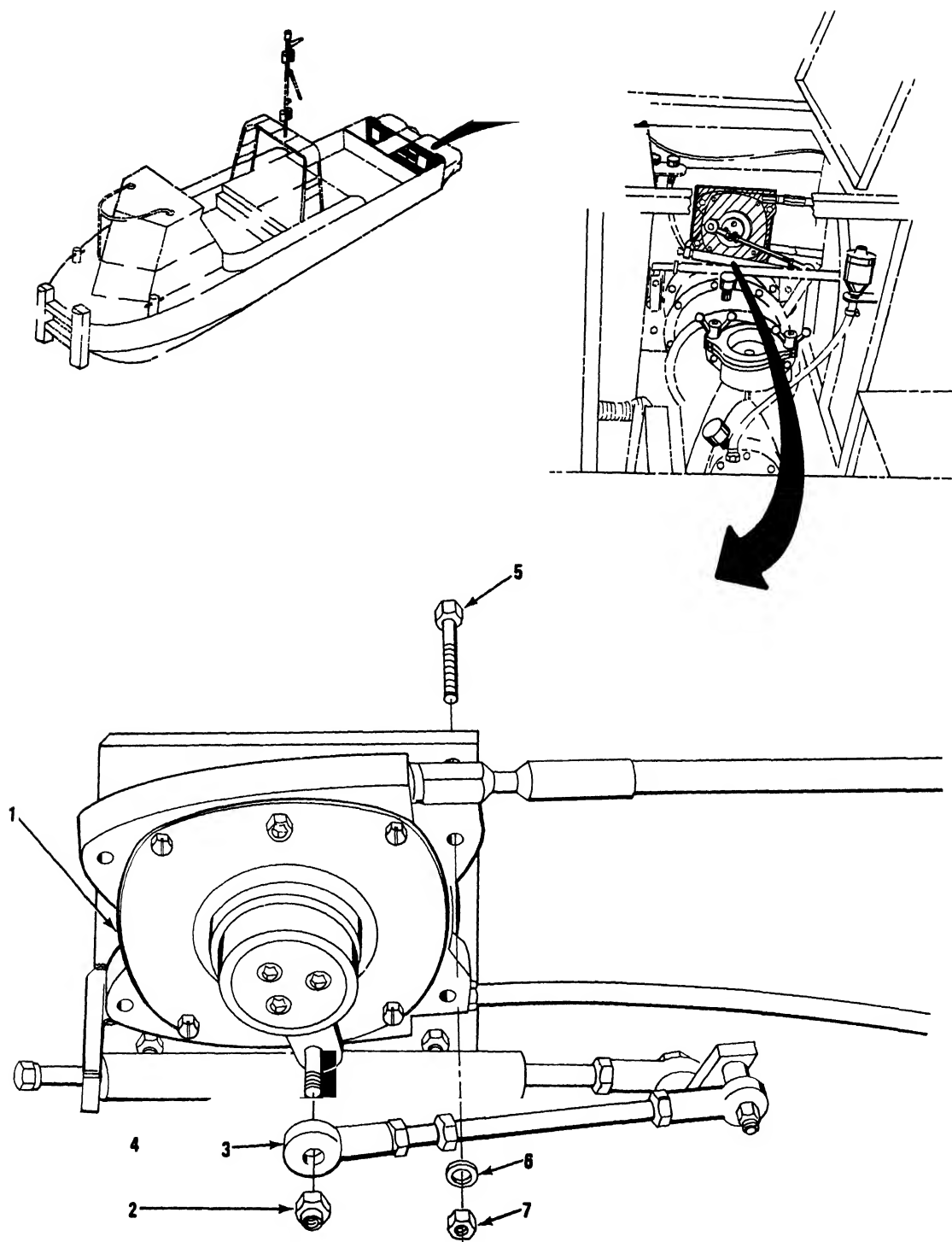
Condition Description

Hydrojet hatches
opened and secured
Steering cable removed

Materials/Parts

Rotary control assembly

ROTARY CONTROL ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



ROTARY CONTROL ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1	Rotary control assembly (1)	a Control rod (3)	a Remove pivot nut (2) Use two 17 mm wrenches
			b Remove control rod (3) from crank (4).
	Rotary control assembly (1)	a Remove and retain 4 nuts (5), washers (6) and bolts (7) Use 1/2 in socket and 1/2 in open end wrench	
		b Remove rotary control assembly (1) Use hands	
<u>INSTALLATION</u>			
2	Rotary control assembly (1)	a Rotary control assembly (1)	a Position assembly (1)
			b Install and tighten 4 bolts (7), washers (6) and nuts (5) Use 1/2 in socket and 1/2 in open end wrench
	Control rod (3)	a Install onto crank (4) Use two 17 mm wrenches	
		b Install and tighten pivot nut (2) Use two 17 mm wrenches	

ROTARY CONTROL ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

NOTE

FOLLOW ON MAINTENANCE PROCEDURE	Do scoop adjustment check (reference TM 5-1940-277-20).
---------------------------------	---

HULL ASSEMBLY REPAIR INSTRUCTIONS

This task covers

- a. Repair
- b. Cleaning
- c. Painting

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Arc welding set, insert gas	TM 5-2090-202-12	Boat on grounded
Non-metallic hammer		cradle
Electric disc sander	TM 5-1940-277-20	Batteries disconnected.
Electric drill		
Twist drill set		
Temperature-indicating crayon		
Hammer		
Metal saw		
 Materials/Parts		
Aluminum plate		
Rivets		
Paint, epoxide undercoat		
Paint, polyurethane top coat		
Sealant, waterproof		
Solvent		

HULL ASSEMBLY REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

NOTE

The exact procedure to be followed in hull repair varies with the location of the damaged or broken section. In the areas above the engine mounting surface and running from the back of battery compartment to the transom there are buoyancy foam blocks that can be removed. In the bow section buoyancy foam is placed and the deck riveted or welded in place. Below engine mount level the space is filled with croffles. Croffles are plastic spheres of two sizes which are 25/32 in (20 mm) and 1-49/64 in (45 mm) in diameter. For those two areas any welding or heating done on the exterior surface must be done carefully to prevent excessive damage to the buoyancy material.

WARNING

Application of flame to buoyancy foam produces an acrid smoke. Inhalation of this smoke may be harmful to personnel. Flame should not be allowed to come in contact with buoyancy foam. Care in heating metal in contact with buoyancy foam must be exercised.

REPAIR

1 Dents

a Minor Dents

Use rubber-headed mallet with back-up mallet on opposite side of the plate. Hammer carefully, first around outer periphery and then work in a spiral to center where dent is greatest.

b Deep Dents

1 Deep dents may require careful application of heat to aid in reforming metal.

2 Use temperature-indicating crayon.

(a) Mark central area of dent with 500°F (260°C) crayon.

(b) Mark rings around central area with 400°F (260°C) crayon.

3 Apply heat until crayon marks begin to melt.

4 Withdraw heat and immediately start hammering.

HULL ASSEMBLY REPAIR INSTRUCTIONS (Continued)

LOCATION

ITEM

ACTION

REMARKS

5. Continued applications of heat may be required.

6. Cool area with a light water spray

7 Cold-hammer remaining minor dents or buckled areas

c. Deep, Small Area Dent

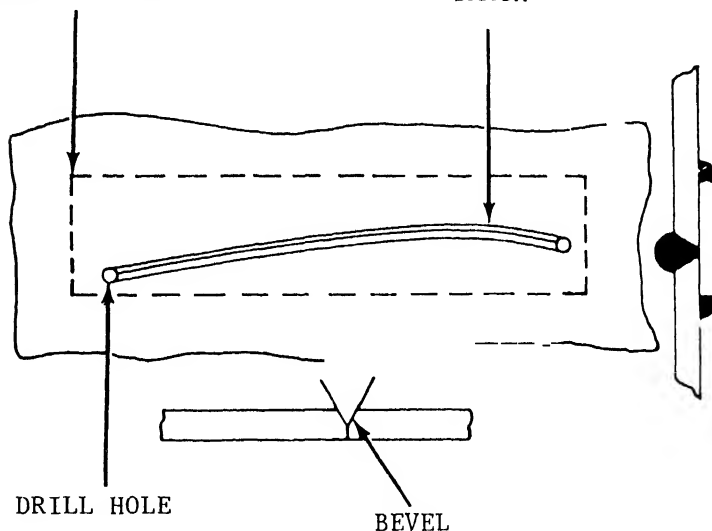
1. Occasionally, a deep small-area dent will not respond to above methods of repair Drill a small hole in the center of the dent This provides room for metal displacement during hammering

2 Repair with one of above methods as required

3. Close hole by welding

BACK UP PLATE

CRACK



DRILL HOLE

BEVEL

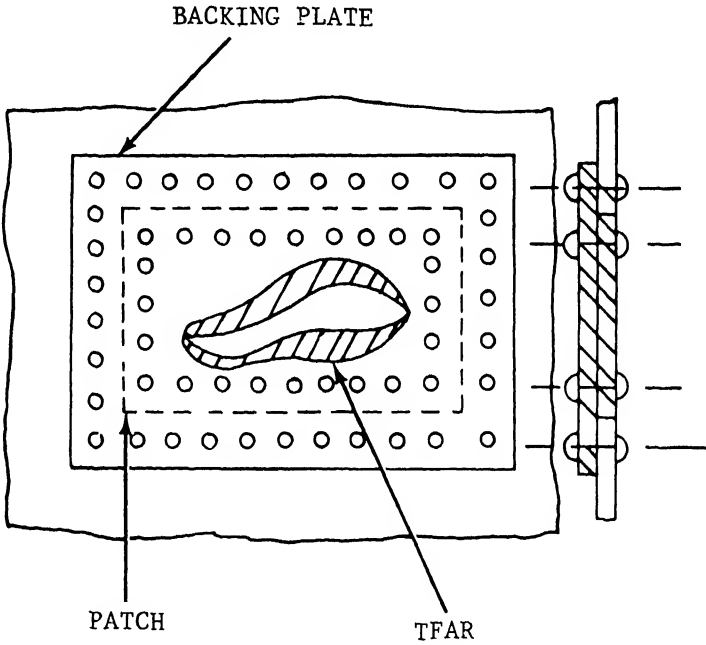
2 Cracks

a Reshape metal using one of methods in 1 above

b Drill a hole at each end of the crack

c Hold aluminum back-up plate against opposite face.

HULL ASSEMBLY REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	d.	Bevel groove using router, chisel, saw or disc sander.	
	e.	Bolt or tack weld, temporarily, back-up plate in position.	
	f.	Weld crack	
	g.	After welding is underway remove bolts if used	
	h.	Weld edges of back-up plate to opposite face of hull plate.	
	 <p>The diagram illustrates a repair procedure for a hull plate. It shows a rectangular 'PATCH' area defined by a dashed line, surrounded by a larger 'BACKING PLATE' indicated by a solid line. Within the patch area, there is a shaded, irregular shape labeled 'TFAR' (Tack Fastener Area). To the right of the patch, a vertical section of the hull plate is shown with several bolts or welds securing the backing plate to the opposite face.</p>		
3	Tears	<p>NOTE</p> <p>Tears may be welded if the metal can be hammered back into position so that the damage may be treated as a crack. Normal crack repair procedure may then be followed. The alternative is riveting.</p> <p>a. Remove the section of hull plate to be replaced by sawing a rectangular hole. Cut hole large enough to remove all damaged metal.</p>	

HULL ASSEMBLY REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	b	Deburr the edges	
	c	Cut a patch of the same material as the hull and size as the hole	
	d	Cut another rectangular plate whose length and width exceed that of patch plate by at least 4 in.	
	e.	Center the patch plate on the larger plate	
	f	Drill a row of holes (size depends on rivet diameter) approximately 1 in from the edge of the patch plate and through both plates (spacing must be not less than 3 times the rivet diameter or more than 24 times the thickness of both plates)	
	g	Rivet the two plates together	
	h	Position the prepared patch in the hole in the hull with the oversize plate on the inside of the hull	
	i	Drill a row of holes approximately 1 in in from the edge of the backing (oversize) plate through the backing plate and hull plate (spacing as in step f)	
	j	Remove the prepared patch and coat the area of the backing plate that contacts the hull plate with a waterproof sealant	
	k	Position the patch and rivet in place	
		NOTE	
		If there is a question about the fit of the patch the seam could be closed by a light weld	
CLEANING, PAINTING			
1		NOTE	
		The surface must be prepared before painting can be undertaken The primary preparation consists of a thorough cleaning. Degreasing is not sufficient.	

HULL ASSEMBLY REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	a.	Be sure all welds have been ground down and area is ready to be painted.	
	b.	Clean the area to be painted with solvent, detergent, or non-etch alkaline cleaner.	
		NOTE	
		Do not use brushes or sanding discs that have been used before Use only new material	
	c.	Rough the surface to be painted using stainless steel wire wool or brush, a disc sander or orbital sander.	
	d.	When surface is clean and dry, apply one coat of epoxide primer	
	e.	Apply a coat of epoxide undercoat and a polyurethane top coat	
	f.	Apply camouflage paint in accordance with local requirements	
		NOTE	
		Painting is needed for antifouling only The aluminum will not corrode where paint has been removed, nor will attack occur between the paint and aluminum to cause adjacent paint to peel off	

CHAPTER 3

GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

- 3-1. **GENERAL.** This section covers general information for disassembly, cleaning, inspection, repair and assembly for component parts of the bridge erection boat. Specific instructions for individual component maintenance are covered in the appropriate sections.
- 3-2. **DISASSEMBLY.** It is recommended that groups of related parts be kept together, preferably in a tray, to prevent their being lost. For those components which have too many or too large parts to use trays it is recommended that the parts be tagged with their name as they are disassembled. This will make it easier to identify parts when assembling the components. Precision matched or mated parts will be marked to insure reassembly in the proper position and place.
- 3-3. **CLEANING** All parts except bearings are to be cleaned as specified in TM 9-247. Bearings should be cleaned as specified in TM 9-214.
- 3-4 **INSPECTION**
- a. **General.** The importance of carefully inspecting disassembled parts cannot be stressed enough. Reassembly of substandard or defective parts can result in needless troubleshooting, disassembly and inspection. Inspection procedures must be performed by experienced personnel using proper tools and equipment. All measuring and testing equipment must be checked periodically and when required accurately calibrated in accordance with current directives. The compilation of complete and accurate inspection records as specified in DA Pam 738-750 is a necessary part of all inspection actions.
 - b. **Metallic Parts** The following procedures should be followed when inspecting metallic parts.
 - (1) All parts should be inspected for cracks
 - (2) Inspect gear teeth retaining ring grooves and mating surfaces for burrs
 - (3) Mating and polished surfaces should be inspected for nicks, scratches and rust. Any nick, scratch, or rust is cause for rejection
 - (4) Short metal parts should be inspected for bends, cracks, tears, broken corners or defective welds
 - c. **Non-Metallic Parts.** Non-metallic parts such as seals and gaskets are not subject to inspection. They will be disposed of upon removal and replaced by new items during assembly.
- 3-5. **REPAIR**
- a. **Hull parts** that are cracked may be repaired by welding if it does not distort or impair the strength of the part. Welding procedures will be accomplished as specified in TM 9-237.

- b. A smooth file or hone may be used to remove small burrs from gear teeth, retaining ring grooves and mating surfaces. The burrs must be very minor and if on gears only on the engaging edge of the teeth.
- c. Damaged painted surfaces should be repainted as soon as possible to prevent corrosion.

3-6. ASSEMBLY. Step-by-step procedures for assembly of the bridge boat components are provided in Chapter 3. In addition the following practices should be observed.

- a. The housing contact surface of oil seals should be coated with a non-hardening sealer to prevent leaks. The lips should be coated with grease (GAA).
- b. All pressing operations should be accomplished using a suitable press and adapters unless otherwise specified.
- c. Metallic parts should be lubricated with the lubricant utilized in the component during operation.
- d. Critical torque values are specified in the assembly procedures
- e. Silicone rubber sealant is used on gaskets and mating surfaces in the engine assembly.

3-7. GENERAL DETAILED PROCEDURE APPLICATIONS

- a. Resources required are not listed unless they apply to the procedure.
- b. Personnel required are listed only if the task requires more than one. If PERSONNEL are not listed it means that one person can do the task
- c. The normal standard equipment condition to start a maintenance task is power (MASTER SWITCH) OFF EQUIPMENT CONDITION is not listed unless some other condition is required besides the (MASTER SWITCH) being OFF

NOTE

Remember the bridge erection boat has two water cooling systems (refer to FO-3)

- d. The MK1 engine WILL NOT be operated without a supply of water to circulate through the raw water system At full speed the system requires 27 gallons of water per minute The MK2 engine WILL NOT be operated out of water for more than 20 minutes at idle speed Any maintenance task step that requires engine operation MUST BE performed with the boat in water or by following Out of Water Engine Operation procedures (TM 5-1940-277-20).
- e. Standard maintenance procedure requires that an operational check be performed after completion of repairs if possible This step is not called out as part of the procedure

GENERAL SUPPORT MAINTENANCE PROCEDURE INSTRUCTIONS INDEX

Procedure	Page
ENGINE	
Cam Follower Inspection	3-5
Cam Follower Replacement	3-5
Oil Pump Replacement	3-9
Piston and Connecting Rod Assembly Inspection	3-15
Piston and Connecting Rod Assembly Repair	3-15
Piston and Connecting Rod Assembly Replacement	3-29
Cylinder Liner Inspection	3-37
Cylinder Liner Replacement	3-37
Main Bearing Inspection	3-47
Main Bearing Replacement	3-47
Crankshaft Inspection	3-57
Crankshaft Replacement	3-57
Camshaft Assembly Inspection	3-75
Camshaft Assembly Replacement	3-75
Camshaft Bearing Inspection	3-75
Camshaft Bearing Replacement	3-75
Engine Block Inspection	3-87
Engine Block Replacement	3-87
TRANSMISSION	
Transmission Repair	3-99
HYDROJET UNIT	
Hydrojet Assembly, Two Stage Repair (Impeller Section)	3-165
Hydrojet Assembly, Two Stage Repair (Drive Section)	3-183



CAM FOLLOWER INSPECTION AND REPLACEMENT INSTRUCTIONS

This task covers

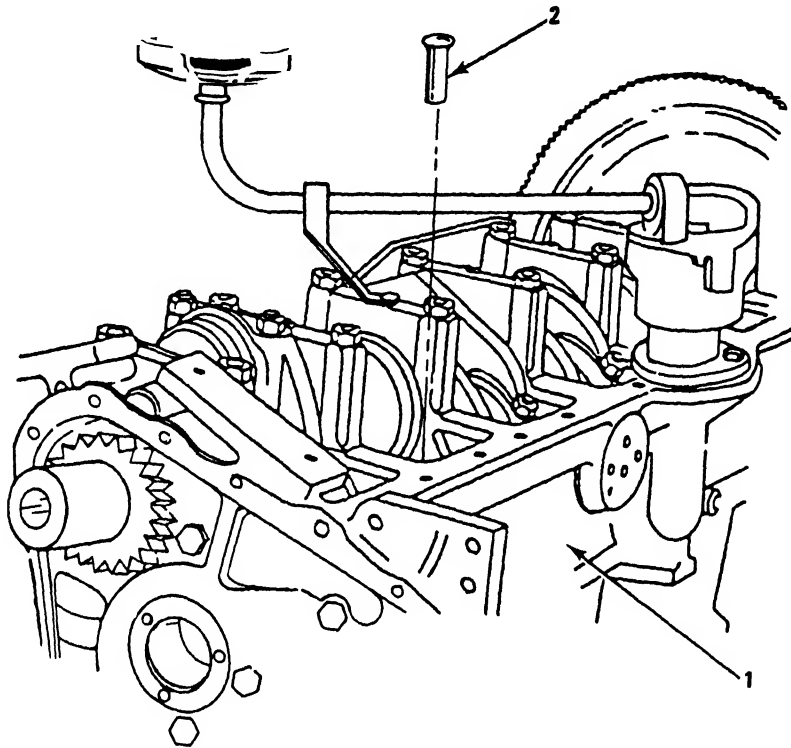
- a. Removal
- b. Inspection
- c. Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Engine maintenance stand	Page 2-179	Engine assembly removed from boat and mounted on engine maintenance stand or laid on side on top of work bench
Materials/Parts		Transmission removed
Set of cam followers	Page 2-345	Flywheel and housing removed
	Page 2-317	removed
	Page 2-307	Oil sump removed
	Page 3-75	Camshaft removed

415 2740 277-34

CAM FOLLOWER INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



LOWER INSPECTION AND REPLACEMENT INSTRUCTIONS
(continued)

ON	ITEM	ACTION	REMARKS
----	------	--------	---------

Cylinder block)	Cam followers (2)	Lift out of cylinder block.	Keep in order for correct reassem- bly if original cam followers are reusable. Rotate crankshaft as needed to get to cam followers.
---------------------	----------------------	--------------------------------	--

CTION

- | | |
|----------------------|--------------------------------|
| Cam followers
(2) | a Inspect for
Cracks, wear. |
| | b Replace if
defective |

LATION

Cylinder block)	Cam followers (2)	Install into bores in cylinder block.	Make sure rein- stalled followers are returned to original posi- tions
---------------------	----------------------	---	--

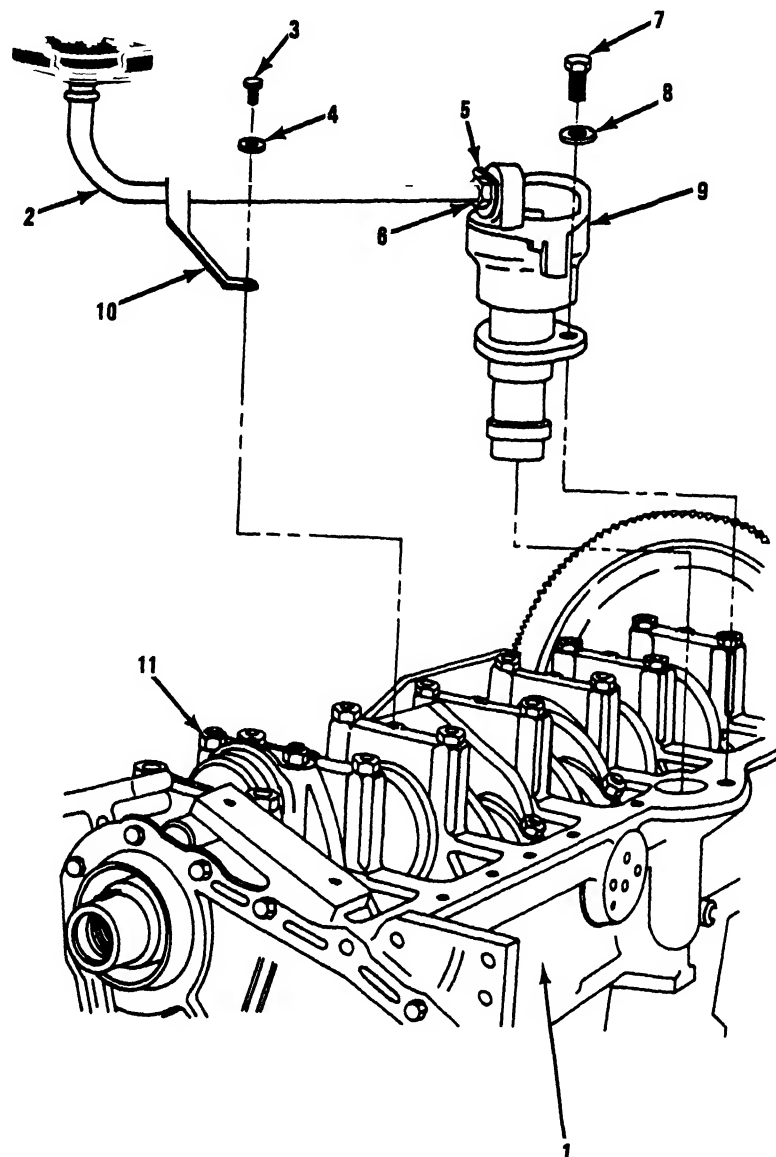
OIL PUMP REPLACEMENT INSTRUCTIONS

This task covers

- a Removal
- b Installation

INITIAL SETUP

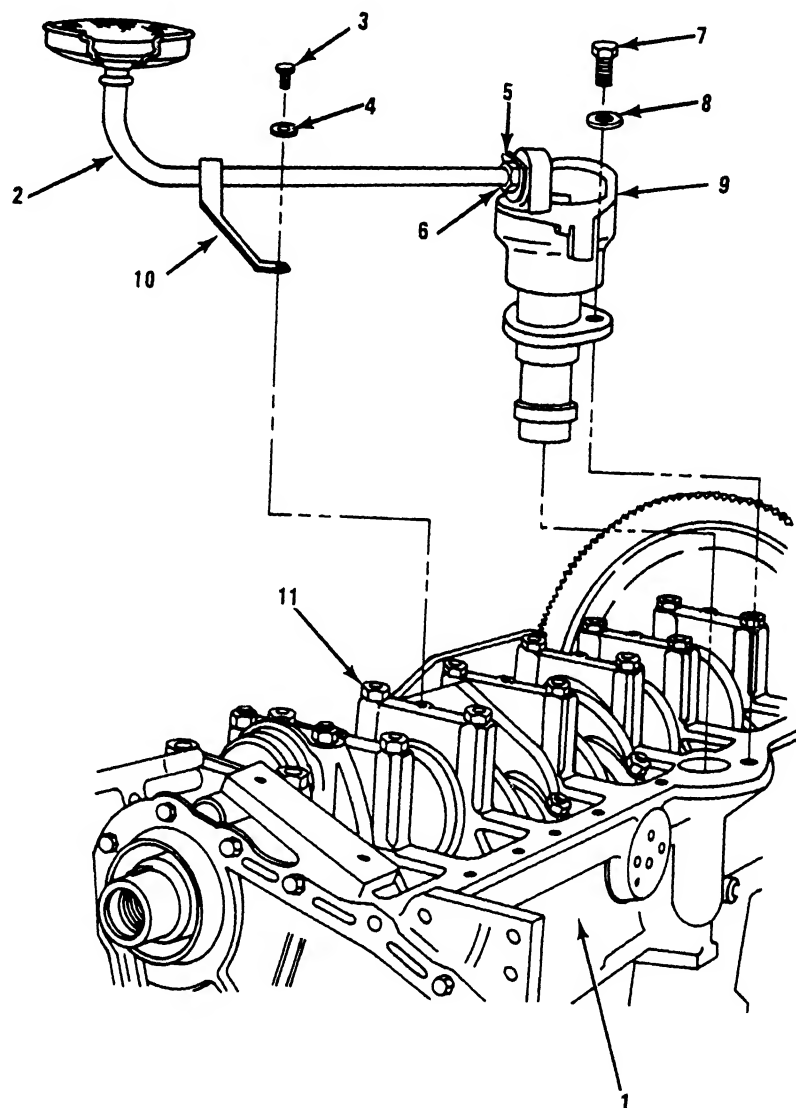
Tools	Equipment Condition	Condition Description
Ratchet	Page 2-179	Engine assembly removed
1/2 in socket		from boat and mounted
7/8 in open end wrench		on engine maintenance
1/2 in box wrench		stand or laid on side
Engine maintenance stand		on top of work bench
	TM 5-1940-277-20	Coolant system drained
Materials/Parts	Page 2-345	Transmission removed
	Page 2-317	Flywheel housing cover
Oil pump		removed
	Page 2-307	Oil sump removed



OIL PUMP REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS	
<u>REMOVAL</u>				
1	Cylinder block (1)	a. Oil pump inlet pipe (2)	a Unscrew and remove cap screw (3) and washer (4)	Use 1/2 in socket and ratchet
			b Bend back lockwasher tab (5) and unscrew pipe union (6).	Use 7/8 in open end wrench
			c Remove	
		b 2 cap screws (7) and 2 washers (8)	Remove	Use 1/2 in box wrench
		c Oil pump (9)	Withdraw from cylinder block (1)	
		<u>INSTALLATION</u>		
2	Cylinder block (1)	a Oil pump (9)	Insert into cylinder block (1)	
		b 2 cap screws (7) and 2 washers (8)	Install and tighten to secure pump	Use 1/2 in box wrench
3.	Oil pump (9)	a Oil pump inlet pipe (2)	a Insert pipe into pump connection	

OIL PUMP REPAIR INSTRUCTIONS (Continued)



OIL PUMP REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. Screw in union (6), bend down lock tab (5).	Use 7/8 in open end wrench.
		c. Secure pipe bracket (10) to main bearing cap (11) using cap screw (3) and washer (4)	Use 1/2 in socket and ratchet

PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS

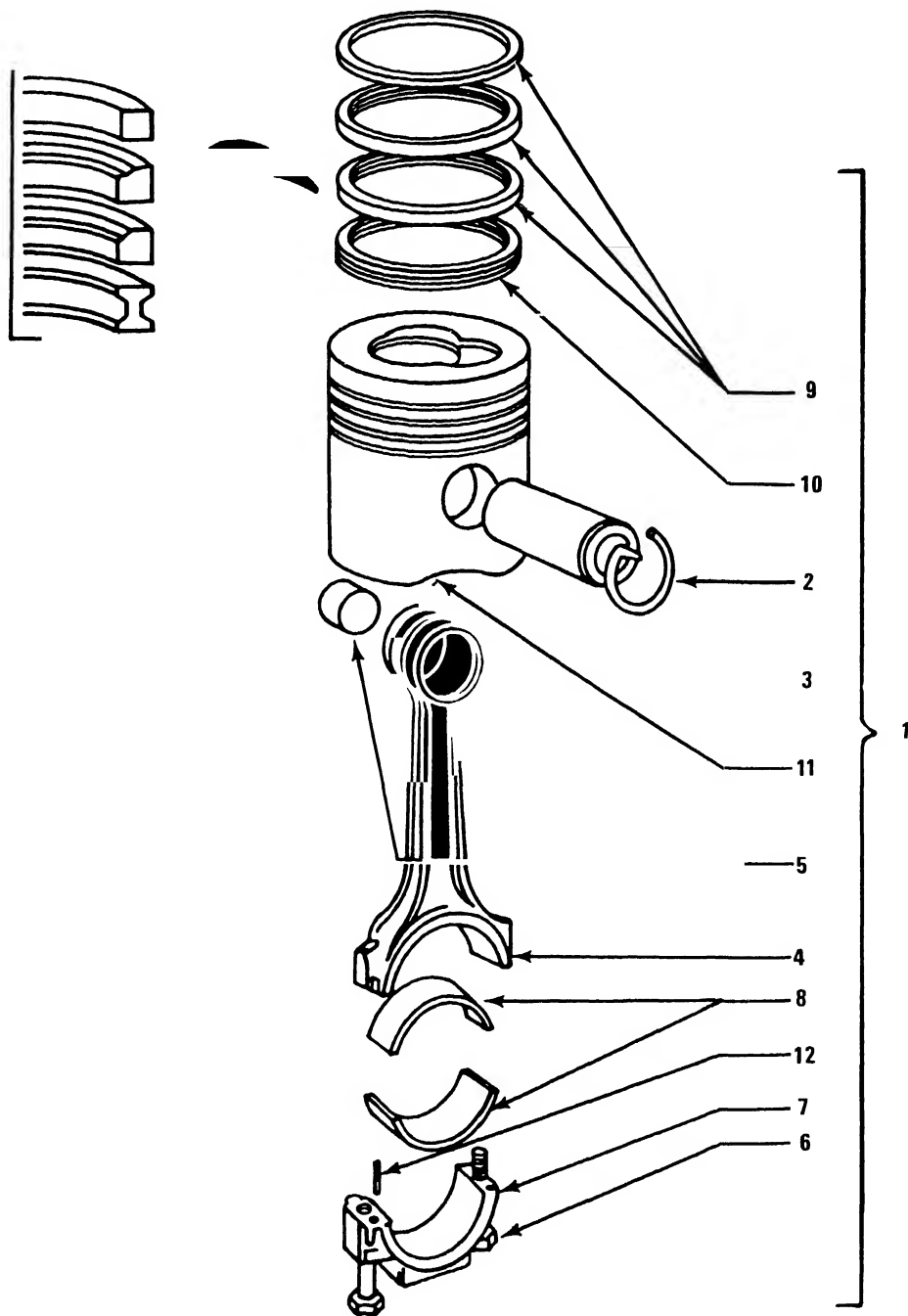
This task covers

- | | |
|----------------|-------------|
| a. Disassembly | c. Repair |
| b. Inspection | d. Assembly |

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Snap ring pliers	Page 3-29	Piston removed from cylinder block.
Drift pin		
Hammer		
Piston ring assembly tool		
Grinding machine		
Feeler gage		
Drilling machine		
Scale		
Materials/Parts		
Snap rings		
Crocus cloth		
Solvent		
Set of piston rings		

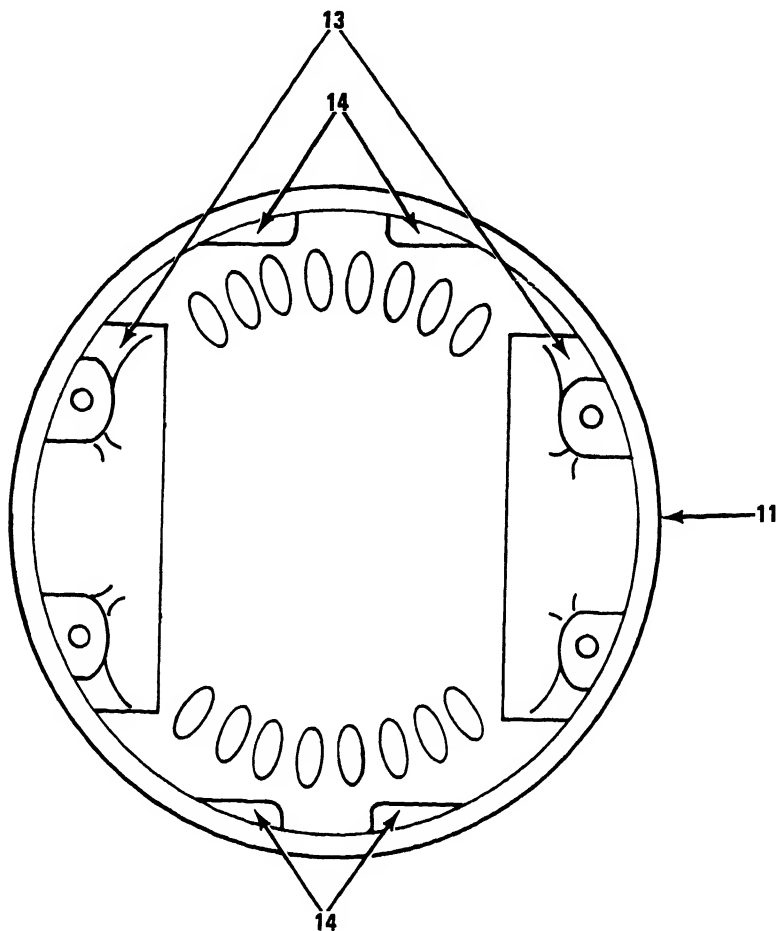
PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)



PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
NOTE			
When disassembling be sure to maintain component identification by piston number. Reinstalled components must be reassembled and installed in original positions.			
<u>DISASSEMBLE</u>			
1	Piston and connecting rod assembly (1)	a 2 snap rings (2)	Remove Use pliers
		b Piston pin (3)	Extract
		c Connecting rod (4)	Separate from piston
		d Small end bushing (5)	Drive out of connecting rod Use drift pin and hammer
		e 2 bearing cap bolts (6), bearing cap (7) and bearing liners (8)	Remove Use hand
		f 4 piston rings (9) and (10)	Remove Use piston ring assembly tool

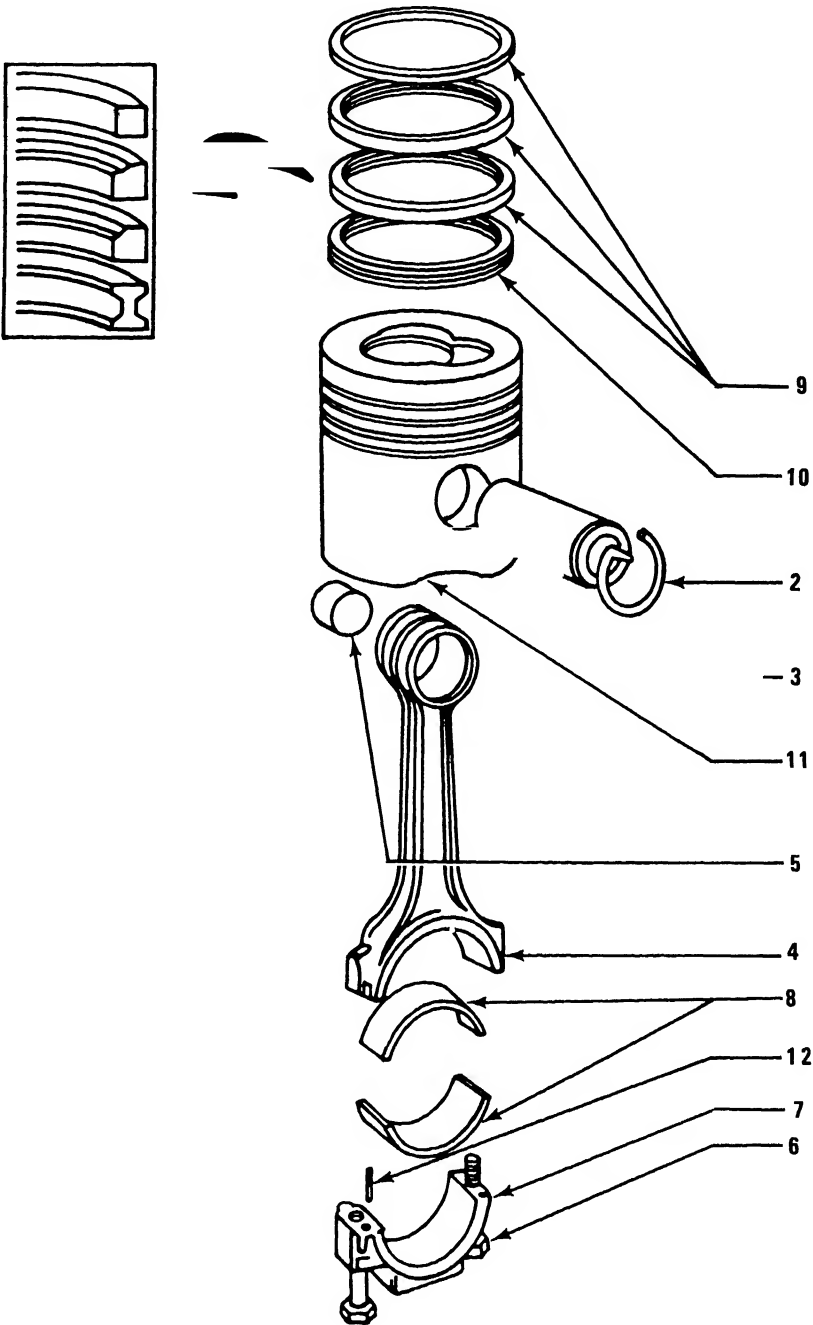
PISTON AND CONNFCTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)



PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>INSPECTION AND REPAIR</u>			
2	Piston (11)	<p>a Inspect walls for Scoring or Scuffing</p> <p>b Inspect inside and outside for cracks at piston pin bosses (13), piston balance strut (14), piston crown and struts between crown and pin bosses</p> <p>c Hone piston if lightly scored</p> <p>d Replace piston if any cracks, scoring, or scuffing noted</p> <p>e Replace piston if piston seized</p>	<p>If heavy scuffing above pin on one side and below pin on other side is noted, inspect for possible bent connecting rod (4)</p> <p>Use grinding machine and crocus cloth</p> <p>If replacing a heavily scored piston, cylinder liner also must be replaced</p> <p>Cylinder liner must also be replaced</p>

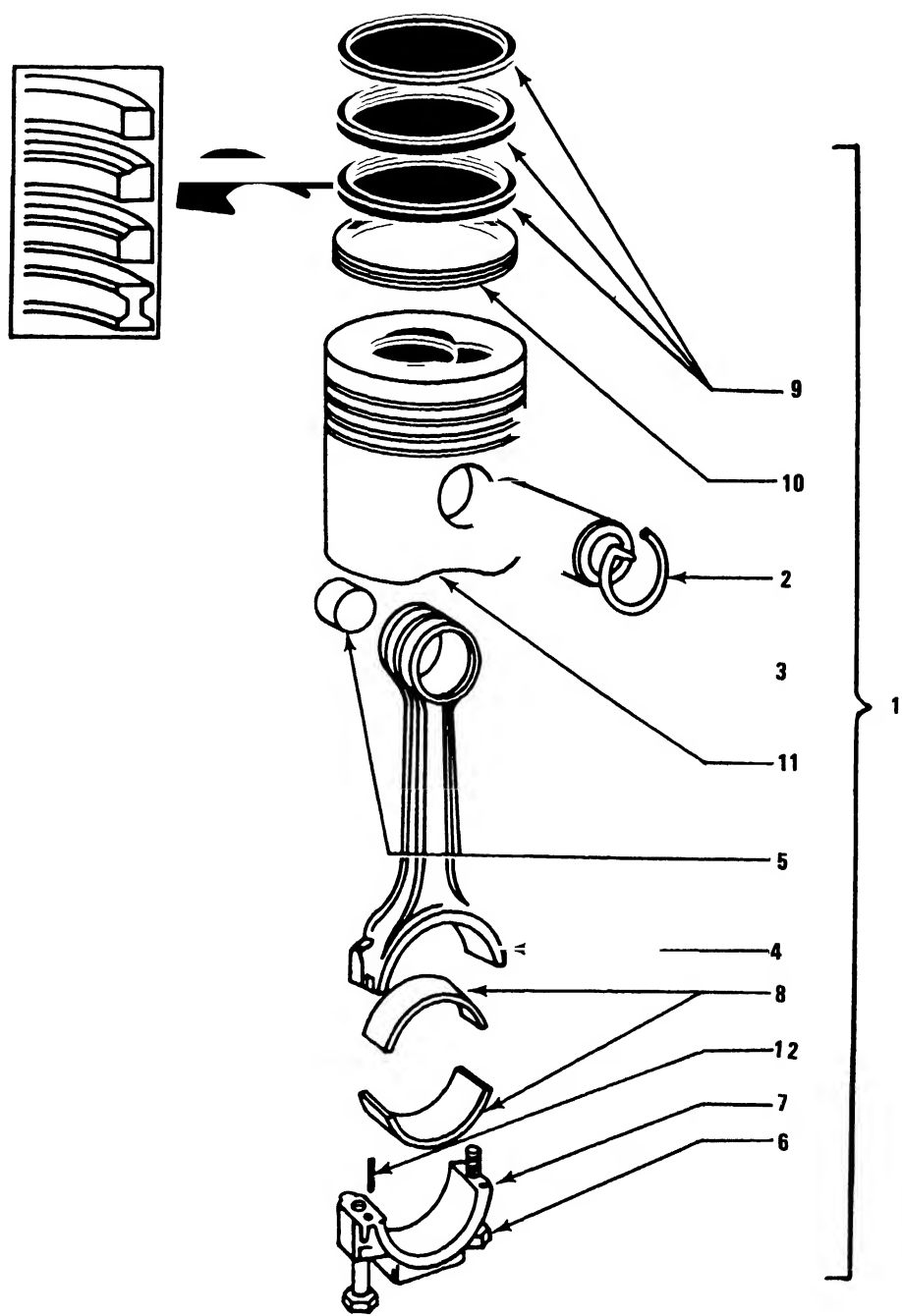
PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTION
(Continued)



PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		f Check clearance in cylinder bore	See page 3-33 for procedures If out of tolerance cylinder liner requires replacement
		g Clean carbon deposit from crown and ring grooves if reusing pistons	Use solvent
3	Connecting rod (4)	a Inspect for cracking, bending	
		b Replace if defect is noted	
4	Piston pin (2)	a Inspect for cracks	
		b Replace if cracked	
5	Small end bushing (5) and bearing liners (8)	a Inspect for scoring, wear, scratching	
		b Replace if any of above is evident	

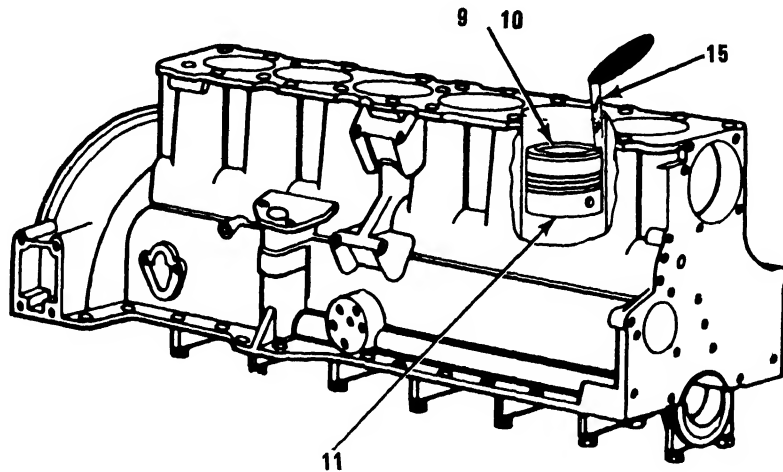
PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND RFPAIR INSTRUCTIONS
(Continued)



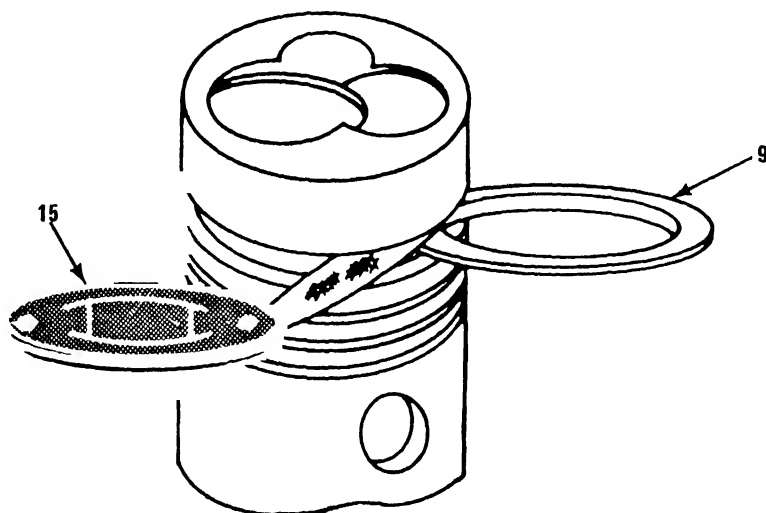
PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS	
		c If small end bushing is replaced, machine bore in bushing to 1 3751 - 1 3754 inch (34 95 to 35 028 mm)	Use drilling machine.	
6	Rings (9) and (10)	(See step 8 below)		
<u>ASSEMBLY</u>				
7	Connecting rod (4)	Small end bushing (5)	Press into place	Aline oil hole in bushing with hole in rod and position the split in bushing to non-thrust side of connecting rod (side opposite to bearing liner locating groove in bearing cap)

PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)



MEASURE PISTON RING GAP



MEASURE RING TO GROOVE CLEARANCE

PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS (Continued)

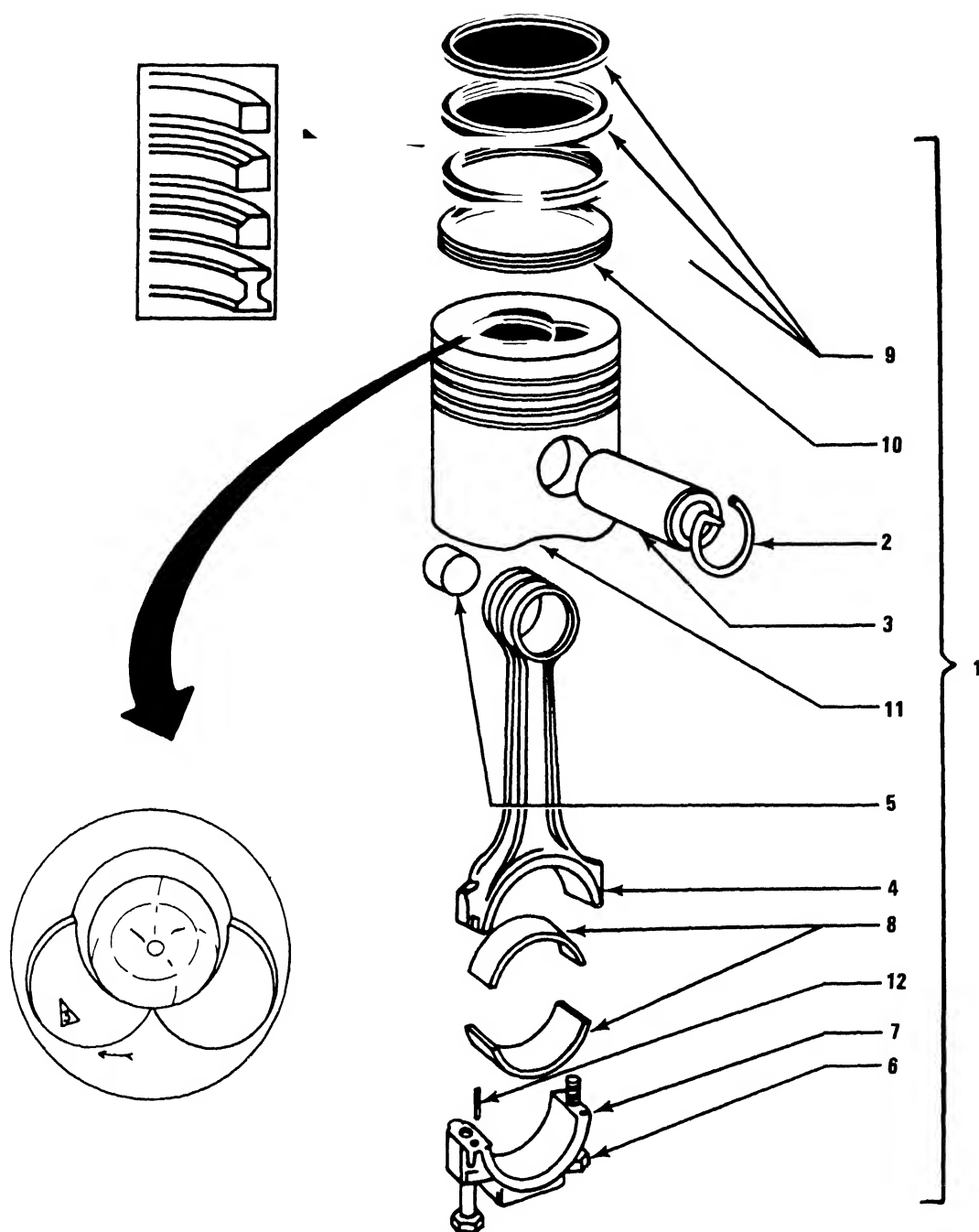
LOCATION	ITEM	ACTION	REMARKS
8	Rings (9) and (10) New rings	<p>a Check each ring for specified gap by</p> <ul style="list-style-type: none"> • Pushing ring into bore to lower portion • Using piston head (11) to make sure ring is square with wall. • Using feeler gage (15), measure gap • Checking against specifications below 	Rings must be checked in cylinder they will be used in.

SPECIFICATION PISTON RING GAP	
Upper Compression	0 016 to 0 031 in (0 406 to 0 787 mm)
Intermediate	0 012 to 0 029 in (0 305 to 0 737 mm)
Lower	0 012 to 0 029 in (0 305 to 0 737 mm)
Oil Control	0 012 to 0 029 in (0 305 to 0 737 mm)

b Check ring to groove clearance Use feeler gage (15)

SPECIFICATION RING TO GROOVE CLEARANCE	
Upper Compression	0 0025 to 0 0040 in (0 063 to 0 102 mm)
Intermediate	0 0027 to 0 0042 in (0 069 to 0 107 mm)
Lower	0 0027 to 0 0042 in (0 069 to 0 107 mm)
Oil Control	0 0025 to 0 0040 in (0 064 to 0 102 mm)

PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)



PISTON AND CONNECTING ROD ASSEMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
9. Piston (11)	a. Connecting rod (4)	Insert into piston	a Make sure arrowhead on piston crown and FRONT mark on connecting rod are pointing in the same direction
			b. Make sure re-installed rod and piston are matched to original mate
	b Piston pin (3)	Insert	
	c 2 snap rings (2)	Install	Use pliers
	d Rings (9) and (10)	Fit to piston	Use piston ring assembly tool Make sure intermediate and lower rings are fitted correct way up (See figure)
10 Connecting rod (4) and bearing cap (8)	a Bearing halves (8)	Fit bearing halves, engaging locating tongues in locating grooves	a If refitting original bearing halves make sure they are mated with their original rod or cap

PISTON AND CONNECTING ROD ASSFMBLY INSPECTION AND REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
			b Aline oil hole in upper bearing half with hole in rod
	b Bearing cap (7) and 2 bolts (6)	Attach to rod	Tighten finger tight
11 Piston and connecting rod assemblies (1)	Piston and connecting rod assemblies (1)	Weigh each assembly	Use scale Maximum variation of weight between assemblies is 1 7637 oz (50 g)

PISTON AND CONNECTING ROD ASSEMBLY REPLACEMENT INSTRUCTIONS

This task covers

- a Removal
- b Installation

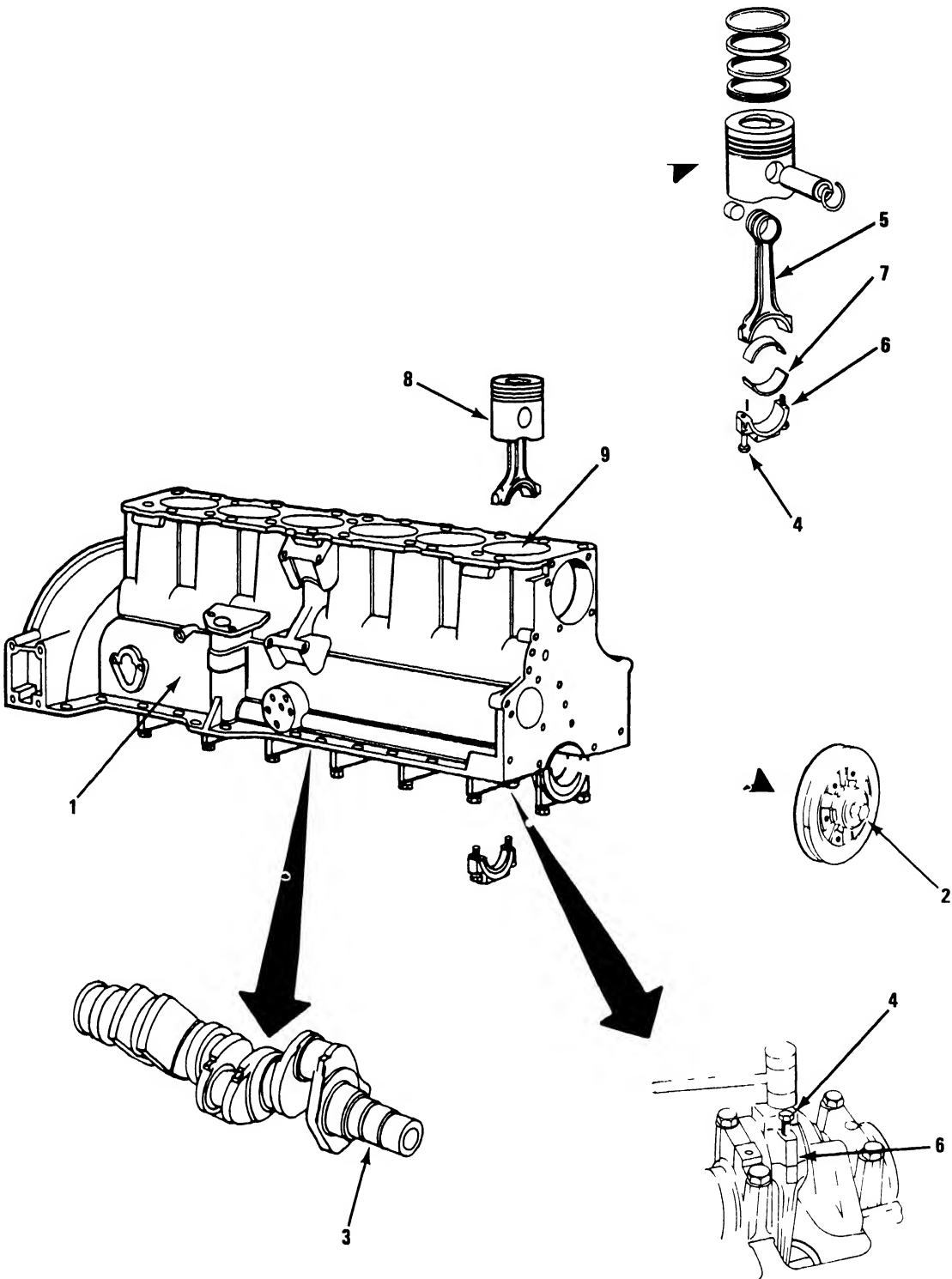
INITIAL SETUP

Tools	Equipment Condition	Condition Description
1/2 in drive hinged handle	Page 2-179	Engine assembly removed
15/16 in socket, 1/2 in drive		from boat and mounted
3/8 in drive ratchet		on engine maintenance
5/8 in socket, 3/8 in drive		stand or laid on side
6 in extension, 3/8 in drive		on top of work bench
Torque wrench (0 - 175 ft-lb)	Page 2-345	Transmission removed
Non-metallic hammer	Page 2-291	Cylinder head assembly
Ring compressor		removed
Engine maintenance stand	Page 2-307	Oil sump removed

Materials/Parts

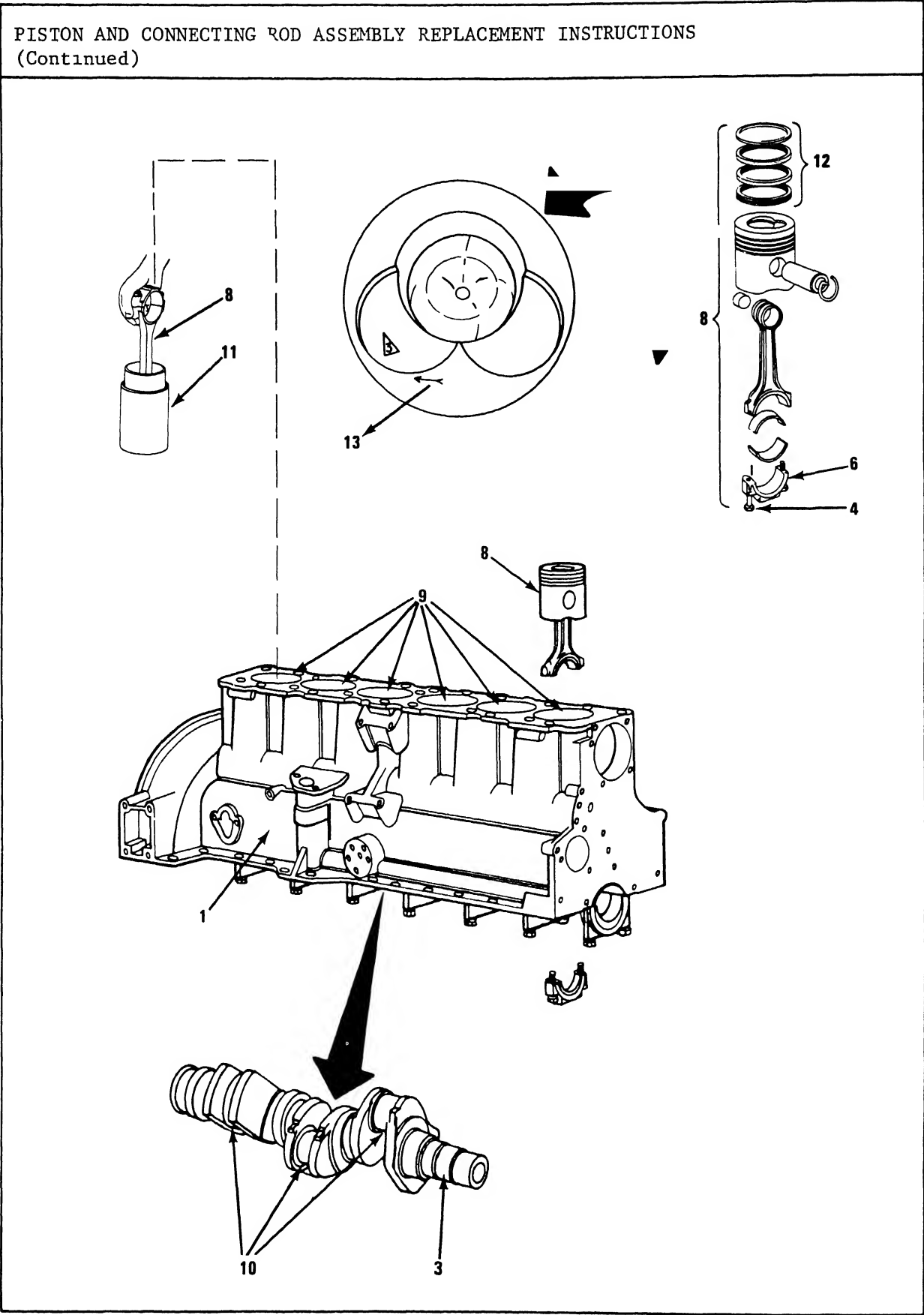
Engine oil

PISTON AND CONNECTING ROD ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



PISTON AND CONNECTING ROD ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

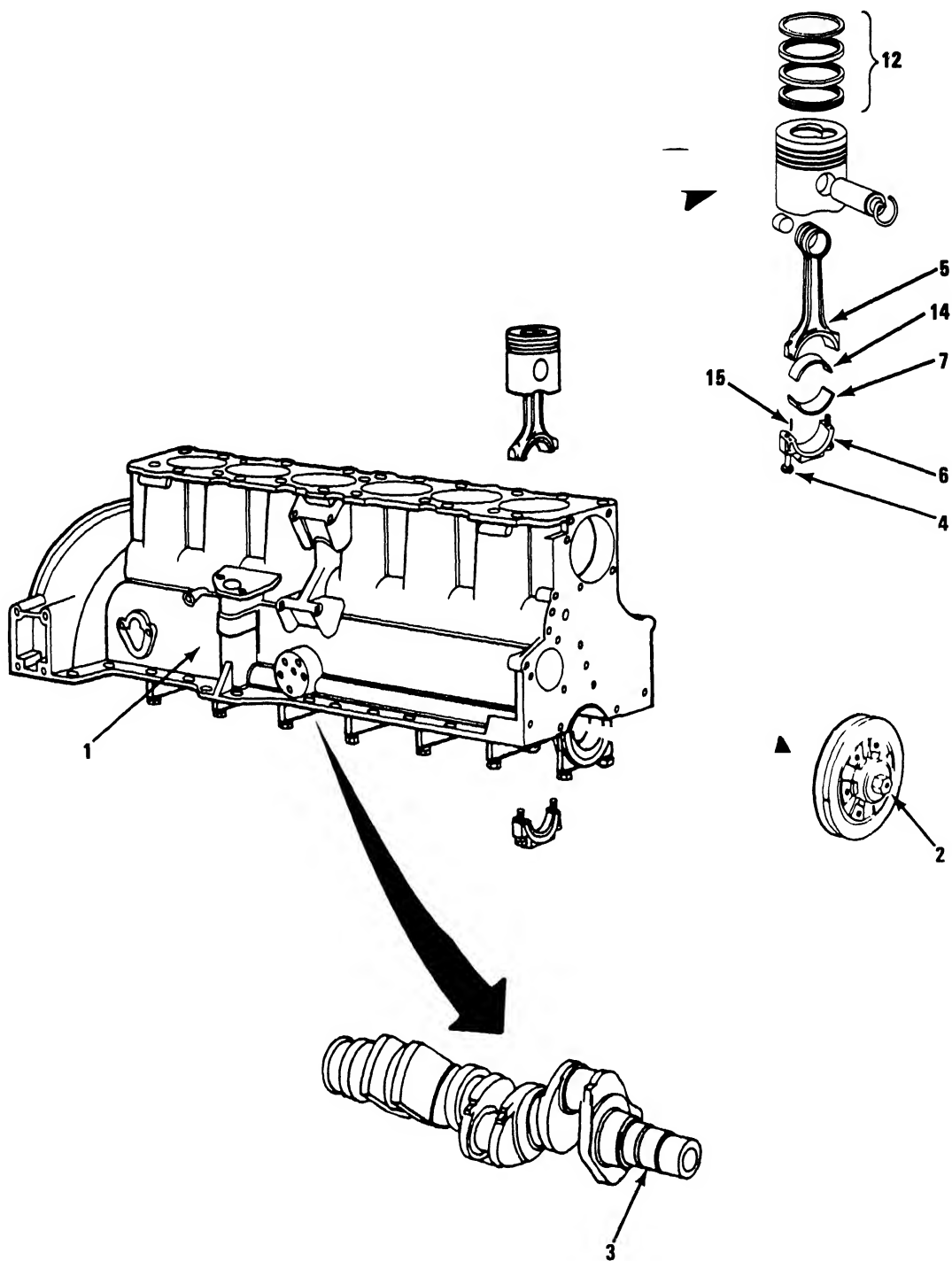
LOCATION	ITEM	ACTION	REMARKS	
<u>REMOVAL</u>				
1	Cylinder block (1)	Crankshaft pulley nut (2)	Turn crankshaft to position piston at bottom dead center	Use 15/16 in socket and 1/2 in drive handle
2	Crankshaft (3)	a. Connecting rod bearing cap bolts (4)	a Loosen bolts	Use 5/8 in socket, 6 in extension and 3/8 in drive ratchet
			b Tap bolts lightly to release connecting rod cap (6)	Use non-metallic hammer
			c Remove bolts	
		b Bearing cap (6) and lower bearing half (7)	Remove lower bearing half	
		c Piston and connecting rod assembly (8)	Push assembly out of cylinder bore (9)	
		d Bearing cap (6), lower bearing half (7) and bolts (4)	Reassemble to connecting rod	Finger tight
NOTE				
Repeat steps 2a - 2d for each piston removed				



PISTON AND CONNECTING ROD ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>INSTALLATION</u>			
3. Cylinder block (1)	a Cylinder block (1)	Rotate onto end	
	b. Cylinder bores (9)	Clean and lubricate	Use clean engine oil
	c Crankshaft journals (10)	Lubricate	Use clean engine oil
4 Ring compressor (11)	Ring compressor (11)	Lubricate inside	Use clean engine oil
5 Piston and connecting rod assembly (8)	a Piston rings (12)	a Lubricate	Use clean engine oil
		b Space ring gaps at 90°.	
	b Piston and connecting rod assembly (8)	a Push into ring compressor (11)	
		b Remove bearing cap (6) and bolts (4)	
6 Cylinder block (1)	a Ring compressor (11)	Position ring compressor over cylinder bore	
	b Piston and connecting rod assembly (8)	Push assembly out of ring compressor into cylinder	Marking (13) on piston crown must point toward engine front

PISTON AND CONNECTING ROD ASSEMBLY REPLACEMENT INSTRUCTIONS
(Continued)



PISTON AND CONNECTING ROD ASSEMBLY REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	c Big end bearing halves, upper (14) and lower (7)	Lubricate with clean lubricating oil.	
	d Connecting rod (5)	Fit open end to crankshaft journal (9)	Rotate crankshaft as necessary
	e Bearing cap (6) and bolts (4)	a Position on connecting rod (5) using dowels (15)	
		b Install bolts, torque to 85 to 90 ft-lb (11 76 to 12 45 kg f)	Use 5/8 in socket, 6 in extension and torque wrench
7 Cylinder block (1)	Crankshaft (8)	Check rotation after tightening each bearing cap (6) by turning crankshaft pulley nut (2)	Use 15/16 in socket and 1/2 in hinged handle

NOTE

Repeat steps 5a - 6e for each piston

CYLINDER LINER INSPECTION AND REPLACEMENT INSTRUCTIONS

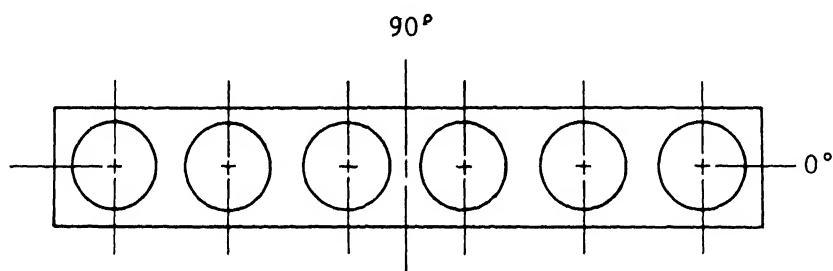
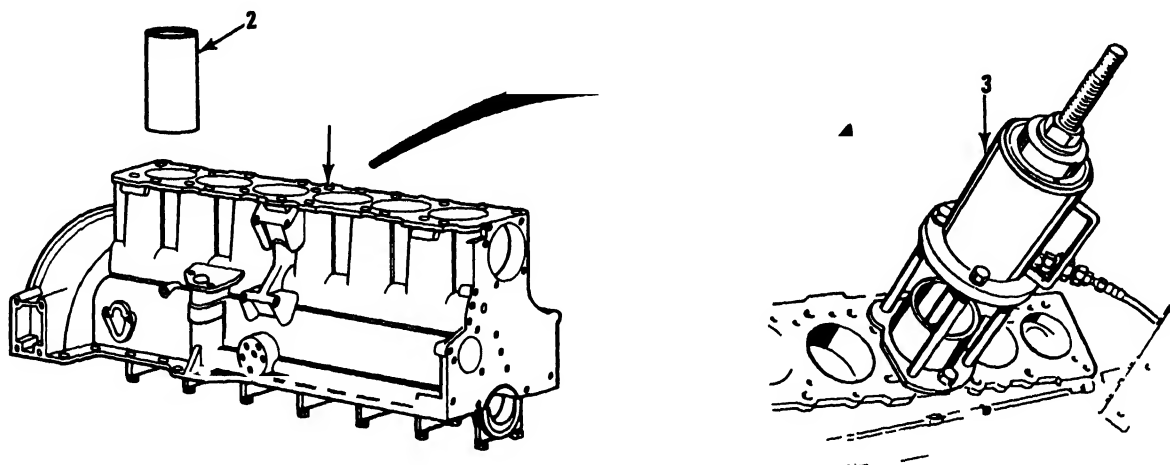
This task covers

- | | |
|---------------|-----------------|
| a. Removal | c. Repair |
| b. Inspection | d. Installation |

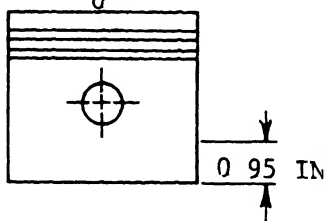
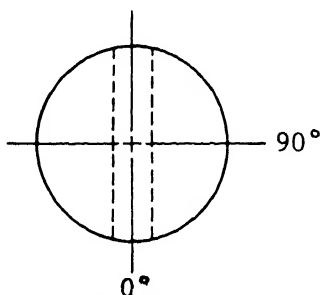
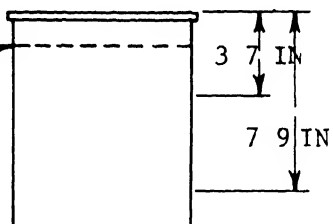
INITIAL SETUP

Tools	Equipment Condition	Condition Description
Cylinder bore honing unit	Page 2-179	Engine assembly removed from boat and mounted on engine maintenance stand or laid on side on top of work bench
Micrometer caliper, inside		
Micrometer caliper, outside		
Wire brush		
Wooden block		
Hammer	Page 2-291	Cylinder head assembly removed
Engine maintenance stand	Page 2-345	Transmission removed.
Special Tools	Page 2-317	Flywheel housing cover removed.
Cylinder liner remover and replacer	Page 2-307 Page 3-29	Oil sump removed. Pistons and connecting rod assemblies removed
Materials/Parts		
Solvent		
Sealant		

CYLINDER LINER INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



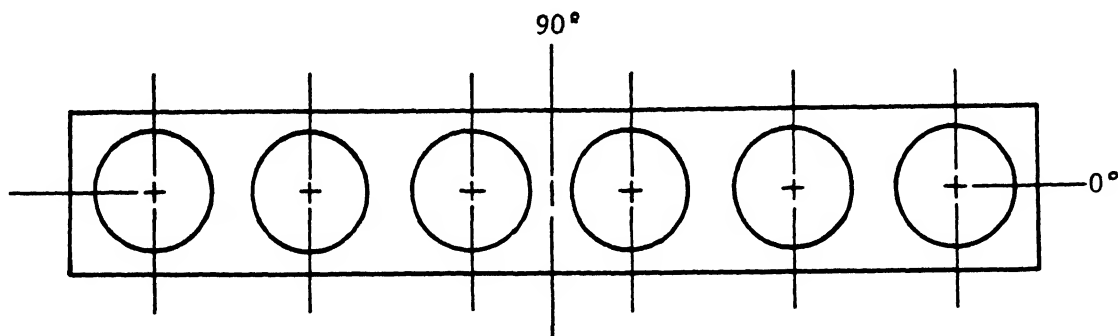
REVERSAL POINT
TOP COMPRESSION
RING



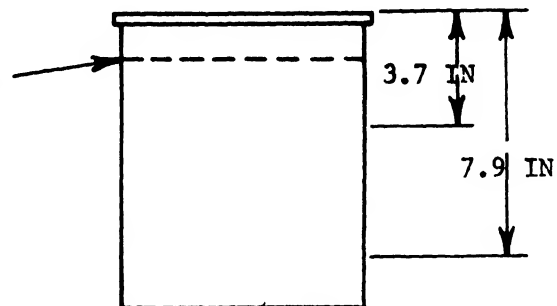
CYLINDER LINER INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1. Cylinder block (1)	Cylinder liner (2)	Remove	Use cylinder liner remover and replacer (3)
<u>INSPECTION AND REPAIR</u>			
2	Cylinder liner (2)	a Inspect for Scoring, Scuffing, or Glazing b Hone if glazed. c Replace if scored or if engine seized	Use cylinder bore honing unit
3	Cylinder liner (2)	Check piston clearance in cylinder liner as follows a Measure liner diameter in line with 0° and 90° to crankshaft as follows (see figure) o Immediately below top com- pression ring reversal point o At 3.7 in (93.9 mm) below top face of block	Use micrometer caliper, inside

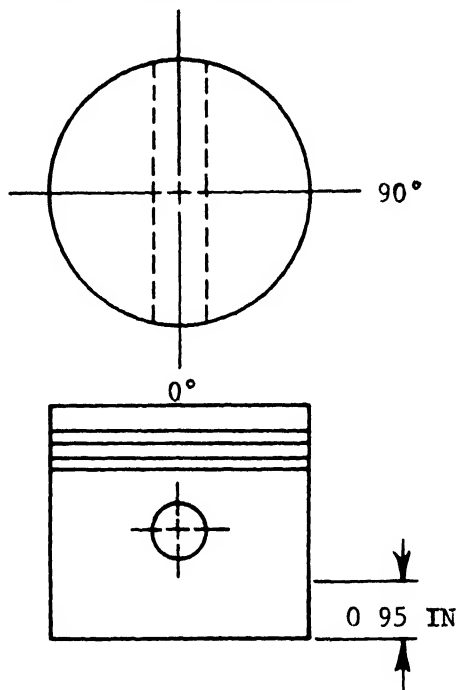
CYLINDER LINER INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



REVERSAL POINT
TOP COMPRESSION
RING



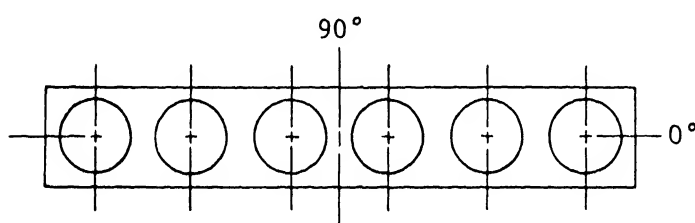
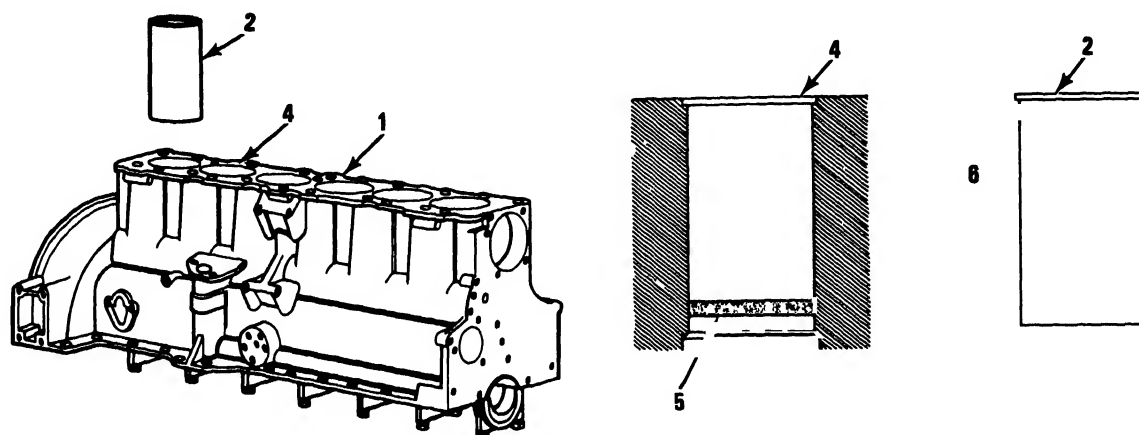
CYLINDER LINER MEASUREMENTS



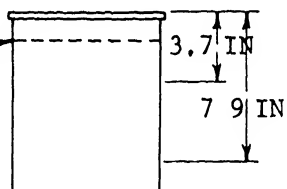
CYLINDER LINER INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		o At 7.9 in. (200 mm) below top face of block.	
		b. Calculate each average cylinder liner diameter of 6 measurements.	
		c. Measure piston diameter at 0.95 in. (24 13 mm) up from lower piston edge at 90° to and in line with piston pin axis (see figure).	Use micrometer caliper, outside.
		d Calculate average piston diameter of 2 measurements	
		e Calculate clearance	This is difference between average liner diameter and average piston diameter.
		f Replace liner if clearance not within limits 0.0058 to 0 0068 in (0 147 to 0.172 mm)	

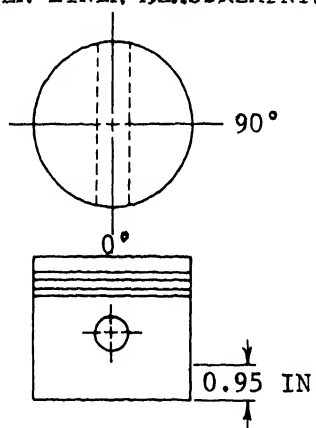
CYLINDER LINER INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)



REVERSAL POINT
TOP COMPRESSION
RING



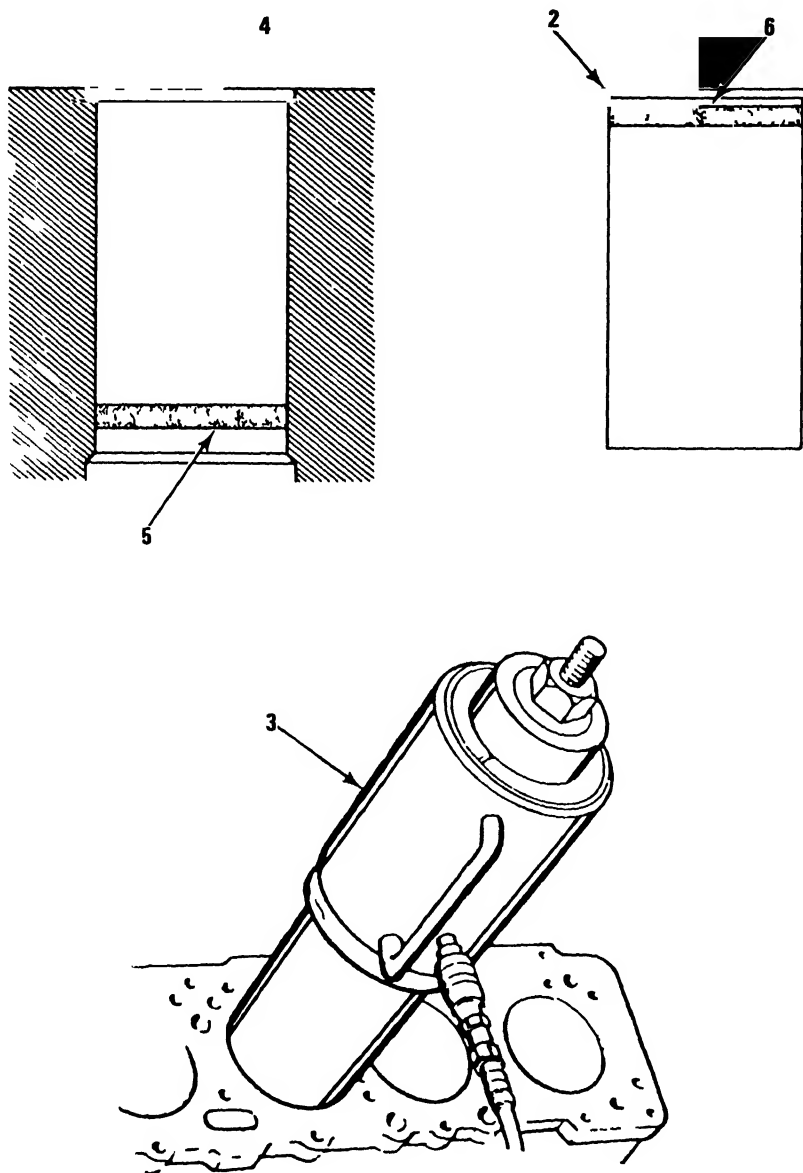
CYLINDER LINER MEASUREMENTS



CYLINDER LINER INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
4.	Cylinder liner (2)	<p>Check roundness.</p> <p>a. Calculate difference in diameters at each level (subtract diameter measured at 0° from that measured at 90°) in bore measured in a above</p> <p>b Replace if measurements are not within 0 003 in (0 075 mm) of each location</p>	
<u>INSTALLATION</u>			
5	Cylinder block (1)	<p>a Cylinder bore (4)</p> <p>a Remove all foreign matter by lightly brushing</p> <p>b Remove all traces of dust and oil</p> <p>c Apply 0 5 in (13 mm) wide band of sealer (5) at bottom (see figure).</p>	<p>Use wire brush</p> <p>Use solvent</p>

CYLINDER LINER INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



CYLINDER LINER INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	b. Cylinder liner (2)	a. Remove protective coating (new liner only). b. Apply 0.5 in. (13 mm) wide band of sealer (6) below cylinder liner lip (see figure). c. Push into cylinder bore as far as possible by hand d. Press home squarely e. Remove any sealer accumulated at bottom of liner f. Check piston to liner clearance - 0 0058 to 0 0068 in (0.15 to 0 17 mm) g. If necessary hone to clearance specification.	Use honing unit Use sealer. Make sure liner recess in block remains clean allowing liner to seat correctly Use cylinder liner remover and replacer. Follow step 3 for procedure. Use cylinder honing unit.



MAIN BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS

This task covers

- a Removal
- b Inspection
- c Installation

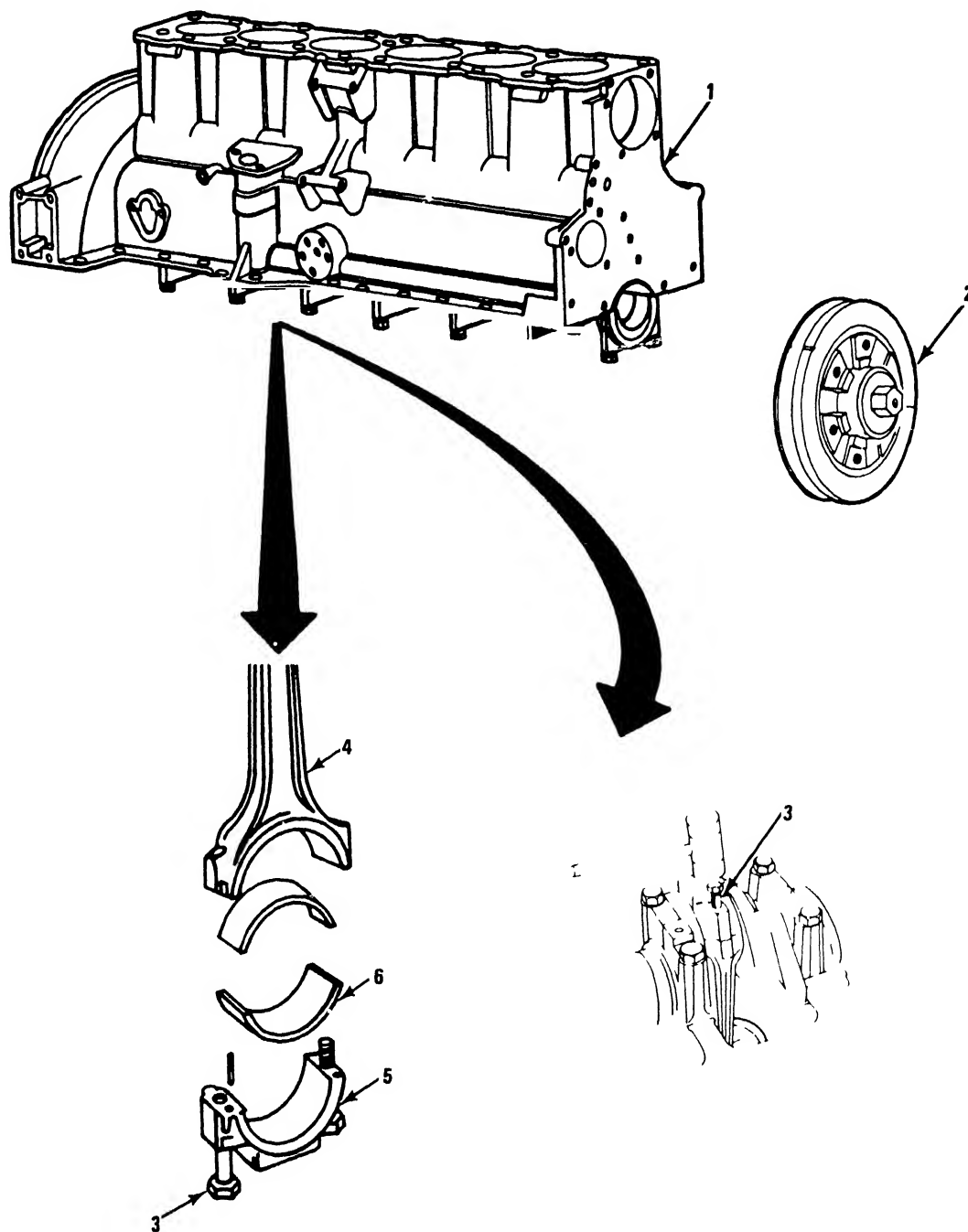
INITIAL SETUP

Tools	Equipment Condition	Condition Description
Torque wrench (0-175 ft-lb)	Page 2-179	Engine assembly removed from boat and mounted on engine maintenance stand or laid on side on top of work bench
5/8 in socket		
Ratchet		
Micrometer caliper, inside		
Micrometer caliper, outside		
Engine maintenance stand	Page 2-317	Flywheel and flywheel housing removed
Non-metallic hammer		
Handle, socket wrench	Page 2-307	Oil sump (pan) removed
15/16 in socket		

Materials/Parts

Shell main bearing wide upper with oil hole (2 each)
 Shell main bearing narrow upper with oil hole (5 each)
 Shell main bearing wide lower (2 each)
 Shell main bearing narrow lower (5 each)

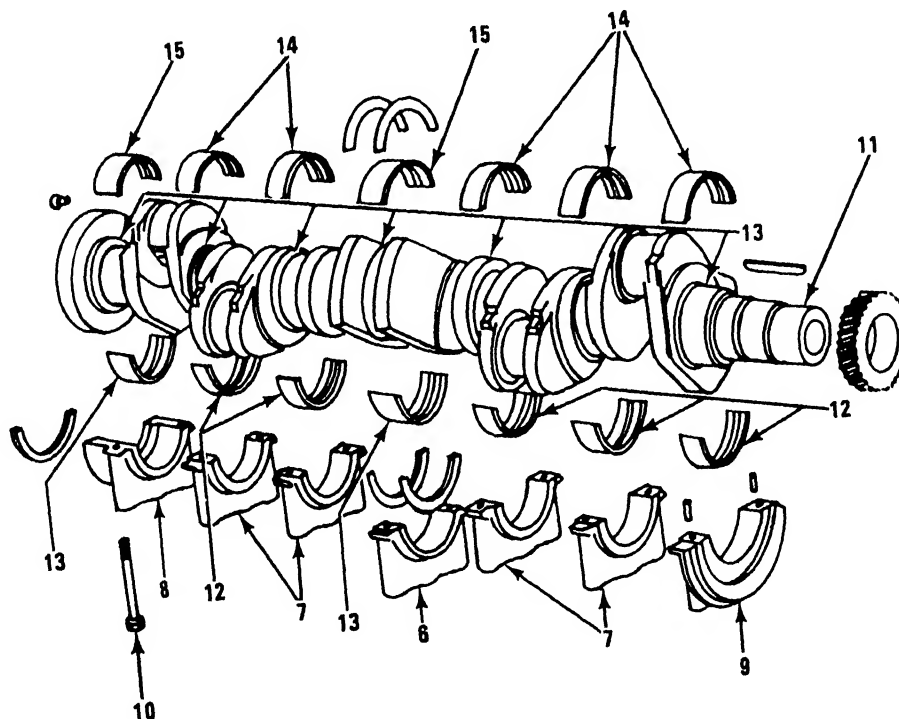
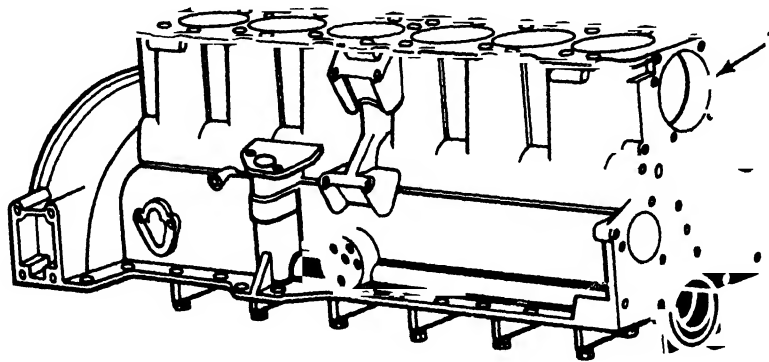
MAIN BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



MAIN BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
NOTE			
Engine is in inverted position on engine maintenance stand or laid on side on top of work bench			
<u>REMOVAL</u>			
1	Cylinder block (1)	a Crankshaft pulley nut (2)	Turn crankshaft to position a piston at bottom dead center
		b Connecting rod bearing cap bolts (3)	a Loosen bolts Use 5/8 in socket, 6 in extension and ratchet.
			b Tap bolts lightly to release connecting rod cap (5) Use non-metallic hammer
		c Connecting rod bearing cap (5) and lower bearing half (6)	Remove lower bearing half
NOTE			
Repeat steps 1a thru 1c for each piston in turn			

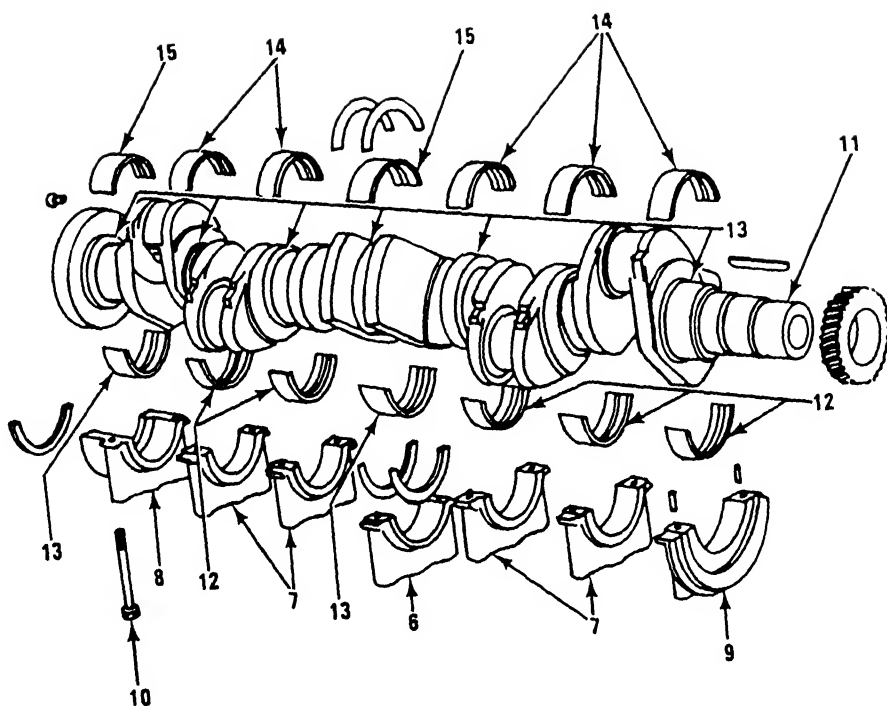
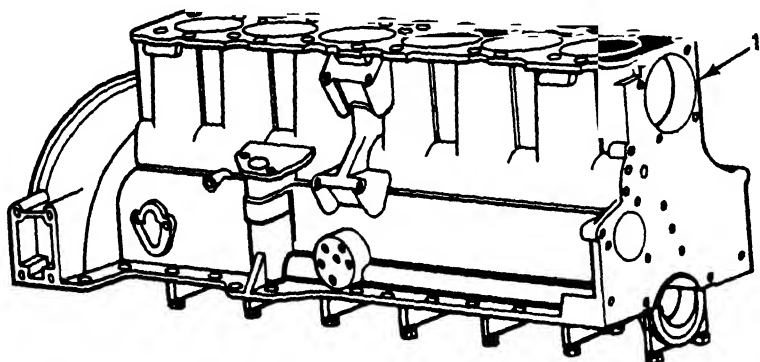
MAIN BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)



MAIN BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	d. Main bearing caps (6,7,8,9), 14 bolts (10) and lower bearing halves (12,13)	Remove	Use 7/8 in socket and 1/2 in drive ratchet
	e Crankshaft (11)	Remove	
	f Upper bearing halves (14,15)	Remove from block (1)	
<u>INSPECTION</u>			
2	Main bearings (12,13,14,15)	a Inspect for scoring or grooving	
		b Replace if scored or grooved	
3	Cylinder block (1)	a Reinstall after crankshaft removal	
	Main bearing caps (6,7,8,9), main bearing halves (12,13,14,15) and 14 bolts (10)	b Torque bolts to 115 - 120 ft-lb (15 89 to 16 58 kfgm)	Use 5/8 in socket and torque wrench (0 - 175 ft-lb)
		c Measure inside diameter of each set of main bearings	Use micrometer caliper, inside

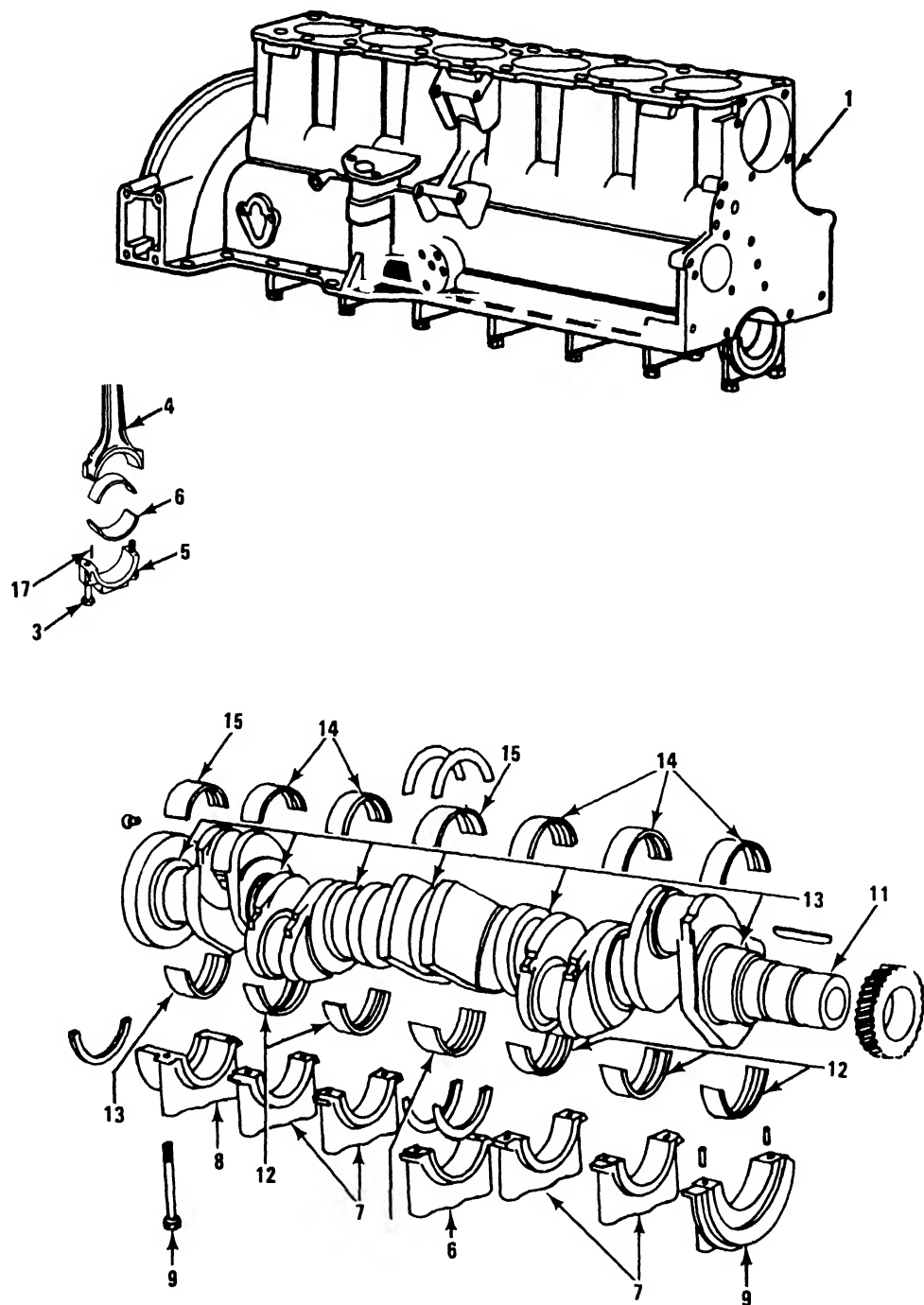
MAIN BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)



MAIN BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
4	Crankshaft (11)	Crankshaft main bearing journals (16)	Measure diameter of journals Use micrometer caliper, outside.
5	Cylinder block (1)	a Main bearings (12,13,14,15) a Determine crankshaft to bearing liner clearance (diameter of step 2c minus diameter of step 3) b Replace all main bearings if clearance is out of limits Specification 0 002 to 0 0041 in (0 051 to 0 104 mm) b 7 main bearing caps (6,7,8,9) and 14 bolts (10)	Remove Use 5/8 in socket and ratchet

MAIN BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



MAIN BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS	
<u>INSTALLATION</u>				
<u>CAUTION</u>				
All upper main bearing halves have oil holes and grooves Do not fit any lower half main bearing liners to upper locations.				
6	Cylinder block (1) and main bearing caps (6,7,8,9)	a New main bearings	a Clean off any preservative	Note that all upper bearing halves incorporate oil feed holes (lower bearing halves do not have holes) and oil grooves Note that center and rear lower bearing halves have oil grooves.
			b Match and fit upper bearing halves (14, 15) to block	
			c Fit lower bearing halves (12,13) to bearing caps (6,7,8,9)	
	b Main bearing caps (6,7,8, 9)	Repeat inspection procedures to make sure clearances are within limits	Repeat steps 3 thru 5	
	c Crankshaft (11)	Install into cylinder block		
	d Main bearing caps (6,7,8,9) and 14 bolts (10)	a Install onto cylinder block		
		b Torque bolts to 115 - 120 ft-lb (15 89 to 16.58 kfgm)	Use 5/8 in socket and torque wrench (0 - 175 ft-lb)	

MAIN BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	e Connecting rod bearing cap (5), lower bearing half (6) and bolts (3)	Fit to connecting rod (4) over crankshaft (11) Use dowels (17) for correct positioning	a Make sure to reinstall cap and bearing halves in original positions b Use 5/8 in socket, 6 in extension and ratchet

CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS

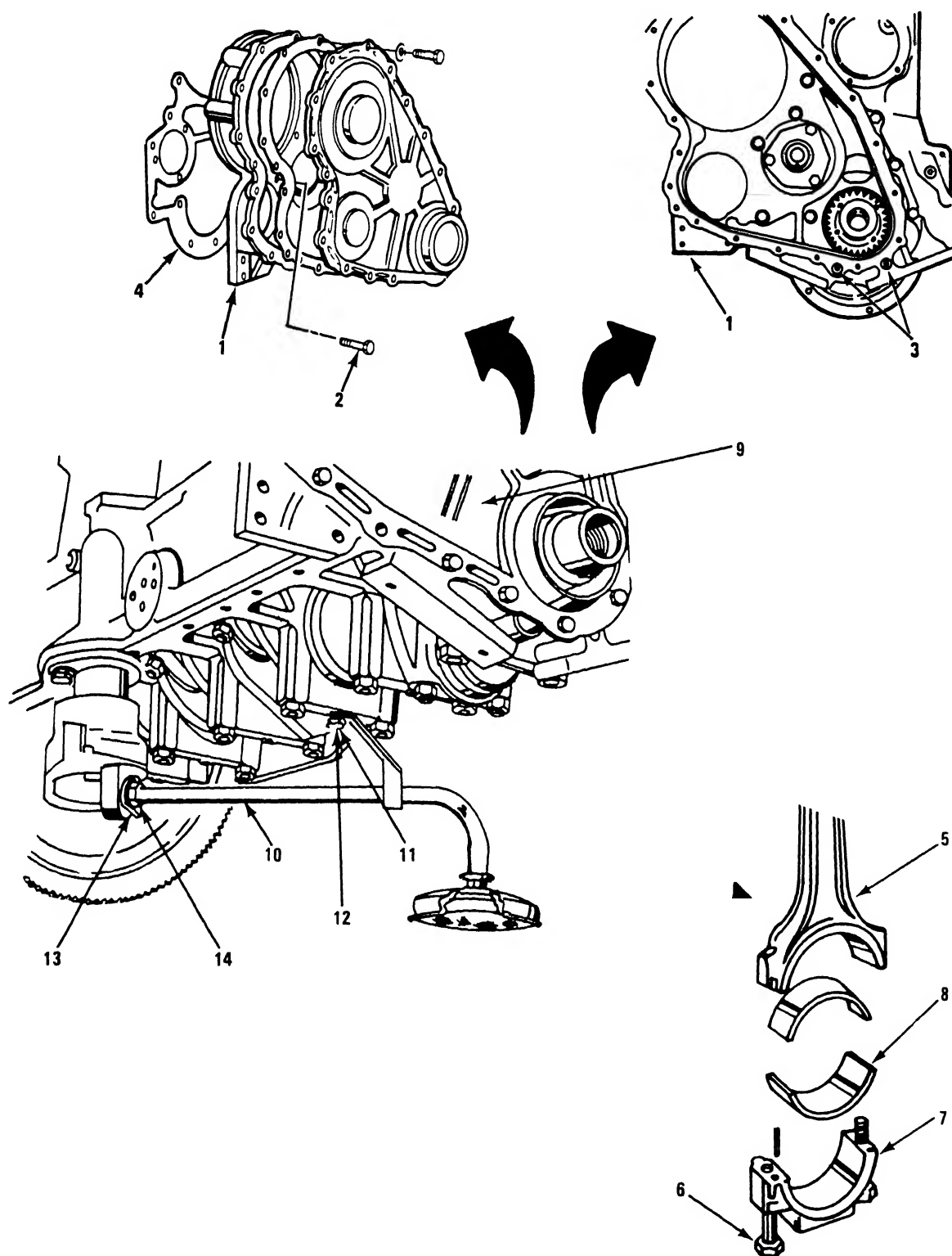
This task covers

- a Removal
- b Inspection
- c Installation

INITIAL SETUP

Tools	Equipment Condition	Condition Description
3/4 in drive hinged handle	Page 2-179	Engine assembly removed from boat and mounted on engine maintenance stand or laid on side on top of work bench
15/16 in socket, 3/4 in drive Ratchet		
Engine maintenance stand		
1/2 in socket		Cooling system drained
9/16 in socket	TM 5-1940-277-20	
5/8 in socket	TM 5-1940-277-20	Water pump and alternator belt removed
7/8 in socket		
6 in extension	Page 2-345	Transmission removed
5/16 in hex key wrench (Allen)	Page 2-317	
7/8 in open end wrench		Flywheel and housing removed
Gear puller	Page 2-307	
Non-metallic hammer		Oil sump (pan) removed
Torque wrench (0 - 175 ft-lb)	Page 3-75 (steps 1 thru 2d)	
Torque wrench (0 - 600 ft-lb)		Camshaft removed
Feeler gage		
Knife		
Drift, brass		
Hammer, ball peen		
Materials/Parts		
Sump and front cover gasket kit		
Sealant		
Engine oil		
Crocus cloth		
Emery paper		

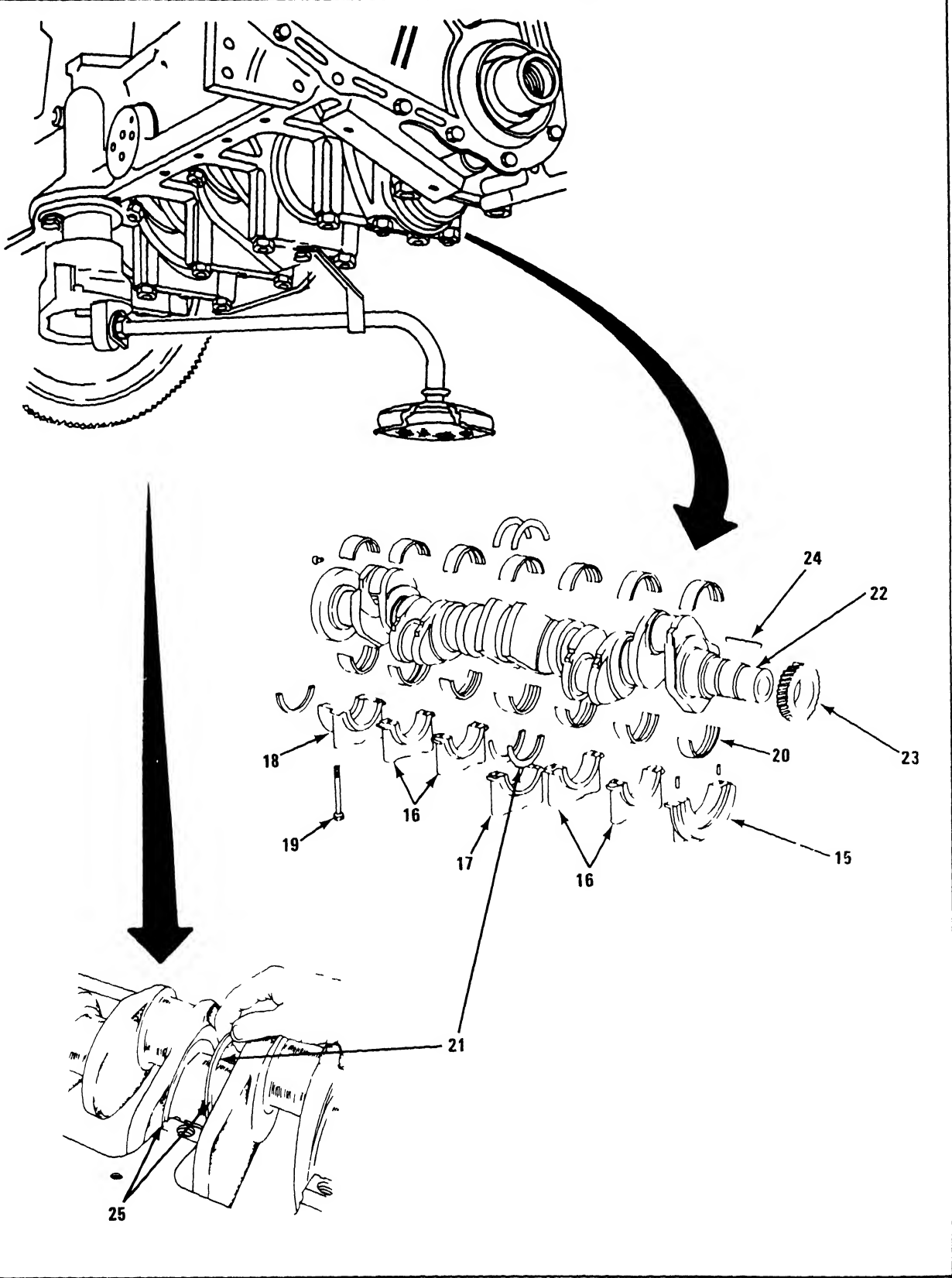
CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1	Timing gear housing (1)	a 8 bolts (2) Remove	Use 9/16 in socket and ratchet.
		b 2 socket head screws (3), housing (1) and gasket (4) Remove	Use 5/16 in hex key wrench (Allen)
2	Connecting rod (5)	12 bearing cap bolts (6), 6 bearing caps (7) and 6 bearing liners (8) a Loosen bolts	Use 5/8 in socket, 6 in extension and ratchet
		b Tap bolts lightly to release connecting rod cap from crankshaft	Use non-metallic hammer
		c Remove caps and liners	Make sure that caps and liners are kept in order for reassembly to original connecting rod
3	Cylinder block (9)	a Unscrew and remove cap screw (11) and washer (12)	Use 1/2 in socket and ratchet
		b Bend back lockwasher tab (13) and unscrew pipe union (14)	Use 7/8 in wrench

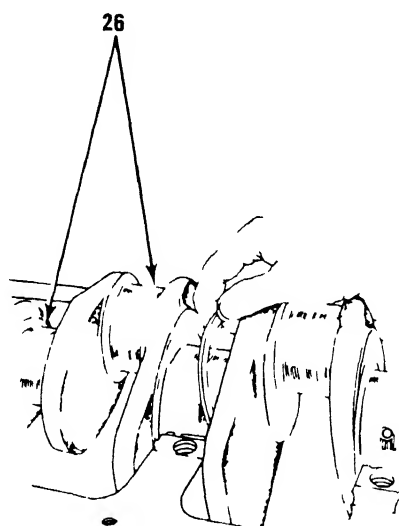
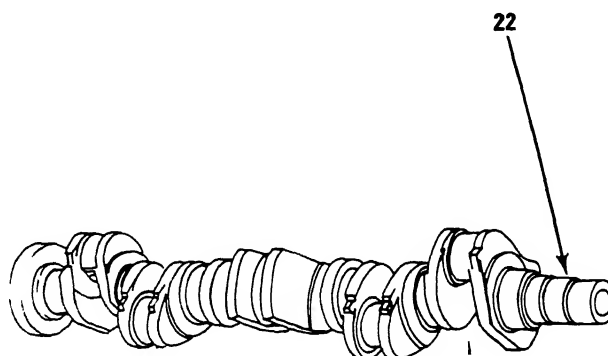
CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



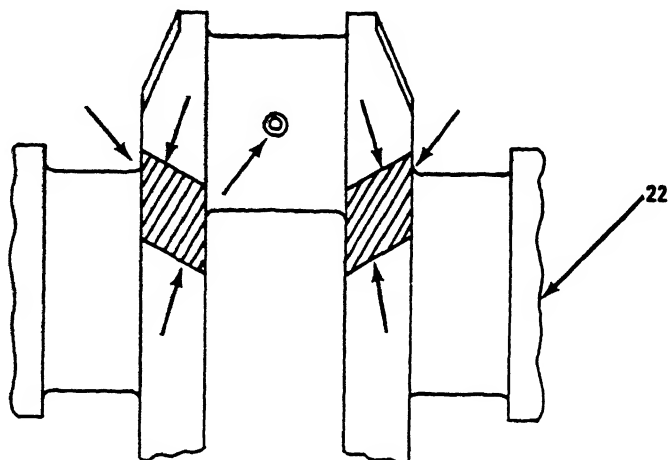
CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		c Remove	
4	Main bearing caps (15, 16, 17 and 18)	a Intermediate main bearing caps (16)	Mark for identification and position
		b 14 bolts (19), 7 main bearing caps (15 thru 18) and 7 main bearings (20)	Remove bolts and bearing caps in turn
		c. Thrust washers (21)	Remove.
5	Crankshaft (22)	a Lift out of block	
		b Remove gear (23)	Use gear puller
		c Remove key (24)	
<u>INSPECTION</u>			
6	Crankshaft (22)	a Center bearing journal thrust surfaces (25)	a Inspect for Grooving and Discoloration
		b Replace shaft if grooved or discolored	Severe damage may indicate a bent shaft

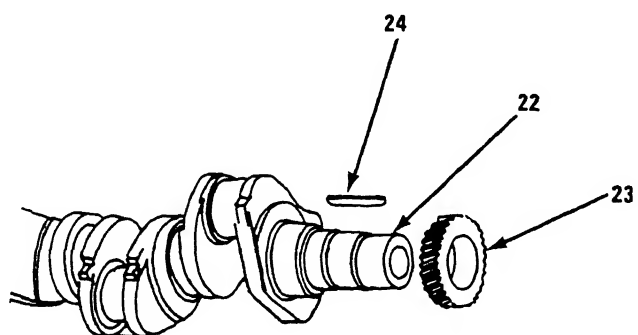
CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



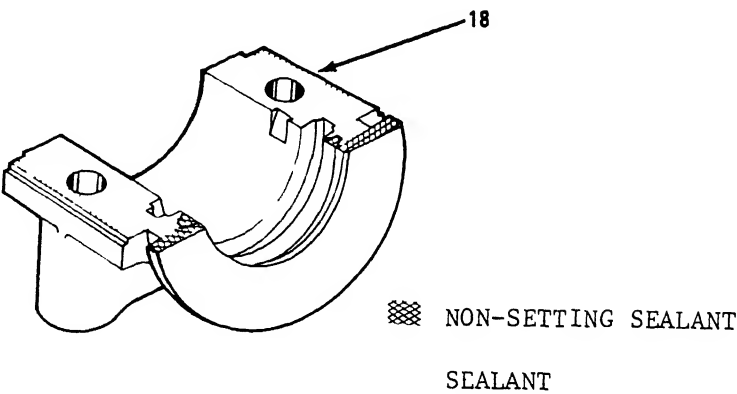
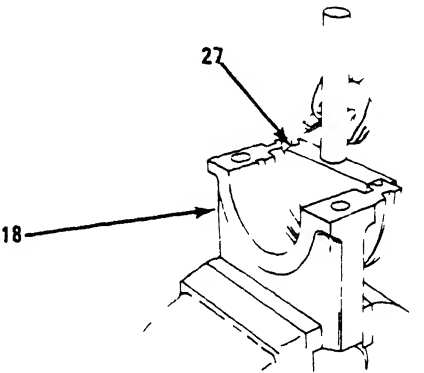
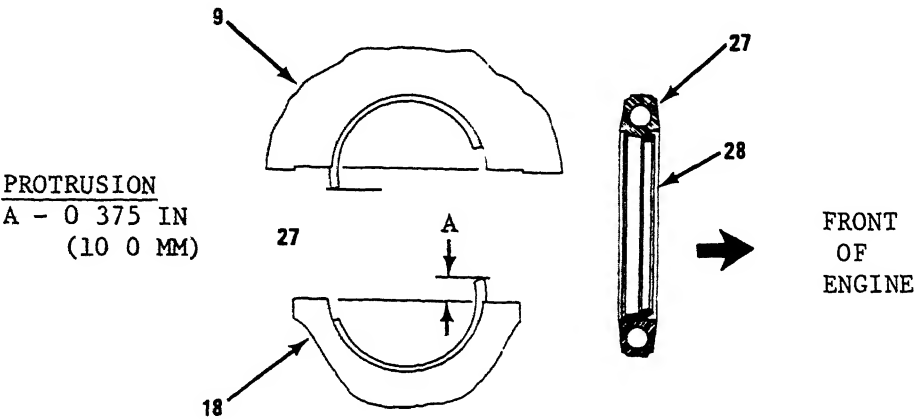
CRITICAL CRANKSHAFT LOADING ZONES



CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	d. Crankshaft (22)	<p>a. Inspect for surface cracks along loading zones (see figure) using one of following methods</p> <ul style="list-style-type: none"> • Magnetic Particle Method, • Fluorescent Magnetic Particle Method, • Fluorescent Penetrant Dye Method <p>b Verify crack indications</p> <p>c Replace if cracked</p> <p>d Replace shaft if heat damage is indicated by discoloration</p>	<p>Check any indicated cracks with a pointed instrument to determine if it is a crack Scratch along crack line to verify cracking</p>
<u>INSTALLATION</u>			
7	Crankshaft (22)	a Key (24)	Install to position gear correctly
		b Gear (23)	<p>Drive onto shaft</p> <p>Use brass drift and ball peen hammer</p>

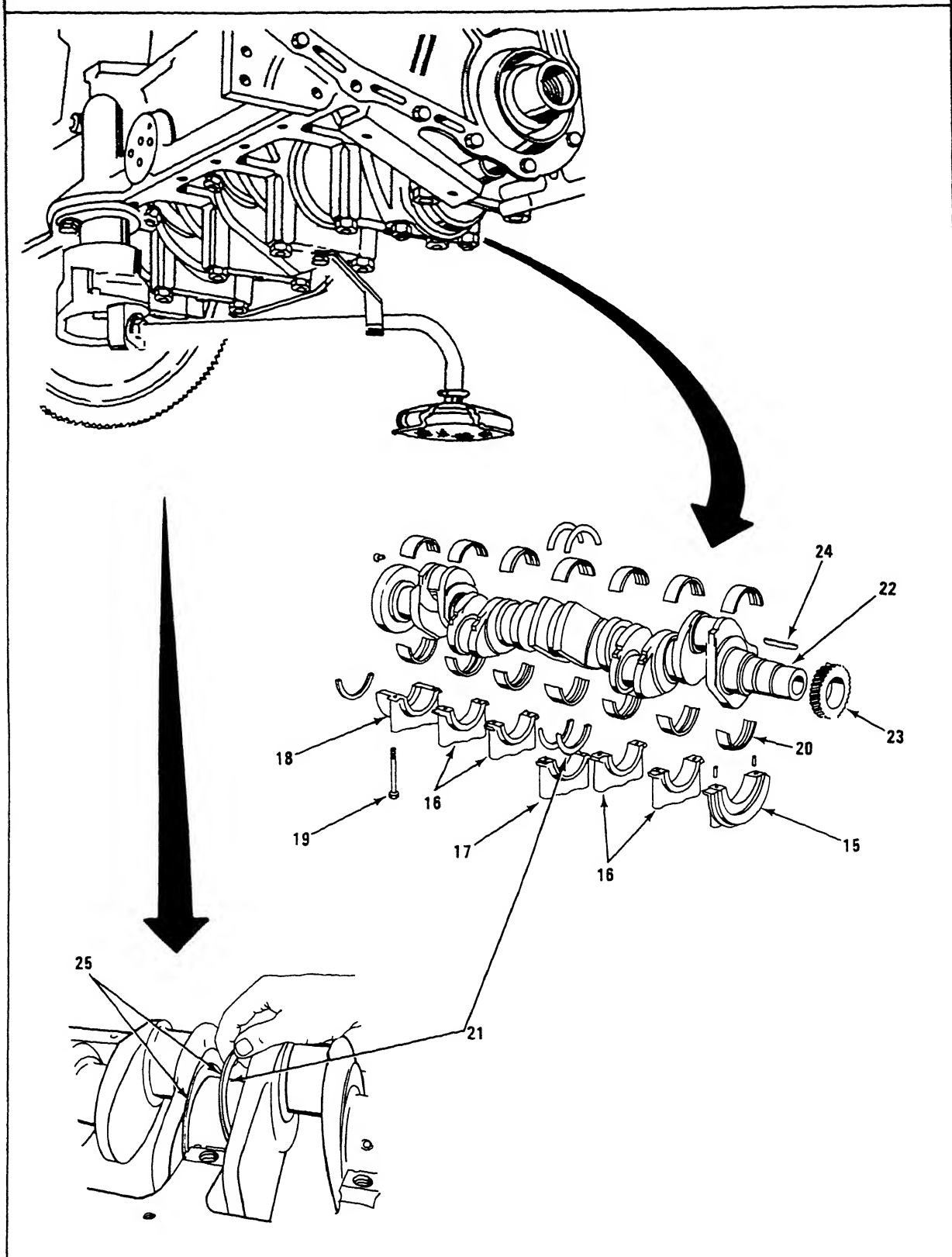
CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
8 Cylinder block (9) and rear main bearing cap (18)	a. Rear main bearing cap (18) and cylinder block (9)	<p>a. Clean out old seal. Make sure all traces of adhesive are removed.</p> <p>b. Coat seal grooves in block and cap with sealant immediately before fitting seal.</p> <p>c. Dip seal halves (27) in clean oil.</p> <p>d. Fit seal (27) into grooves. Note in figure that seal undercut (28) is placed toward front of engine.</p> <p>e. Trim ends of seal to 0.375 in (10.0 mm) above surface (see figure). Use knife. Make sure there are no frayed threads after trimming. Seal halves must protrude to ensure cap alignment.</p> <p>f. Apply non-setting sealant to ends of seal and along rear edge of bearing face (see figure).</p>	

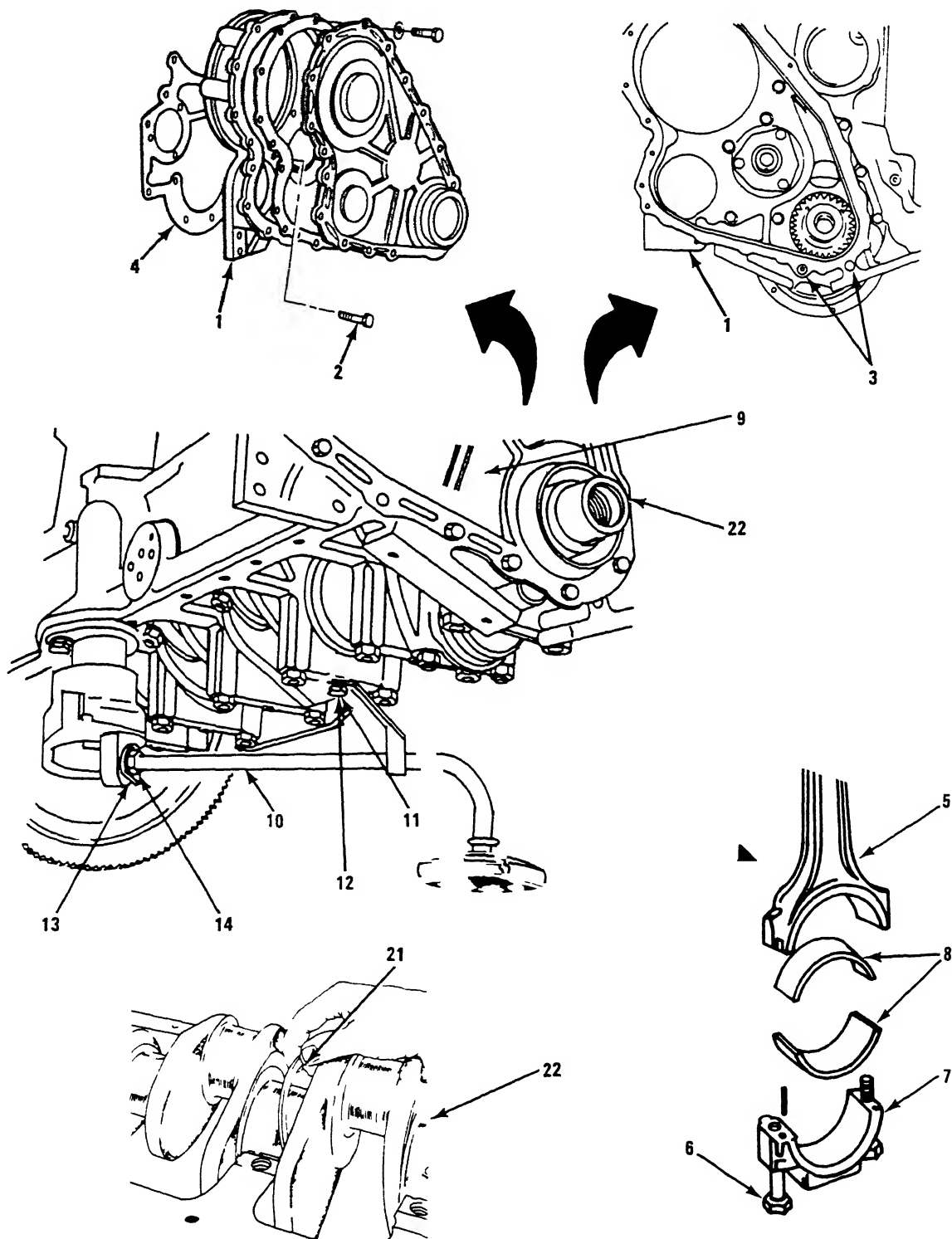
CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	b. Main bearings (20)	a. Clean. b. Lubricate. c. Check that locating tongues are engaged in locating grooves in block and caps	Use clean engine oil.
	c Crankshaft (22)	Install in cylinder block	
9 Crankshaft (22)	a Thrust washers (21)	Fit on either side center main bearing with oil groove facing crankshaft flange	
	b Main bearing caps (15, 16, 17 and 18) and 14 bolts (19)	a Fit caps in correct posi- tion b Lubricate bolt threads c Insert bolts into caps d Move crank- shaft back and forth to centralize center cap.	Match mating marks, make sure word REAR at back of cap Use engine oil Finger tight

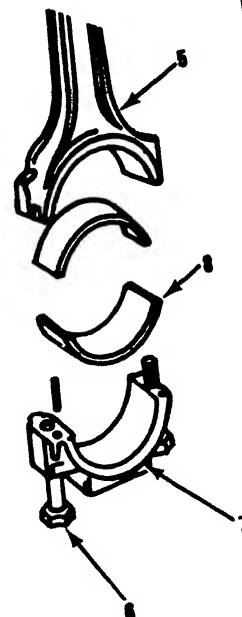
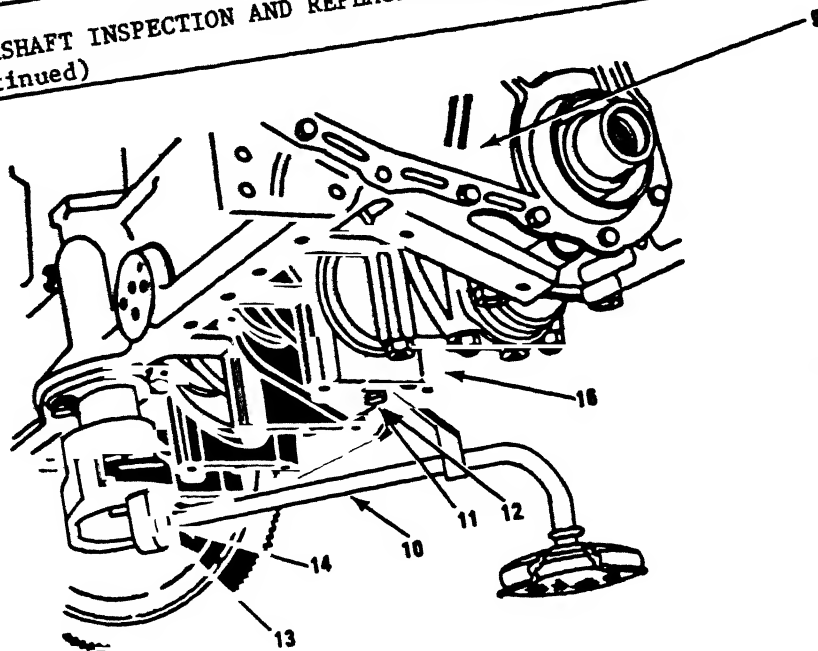
CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

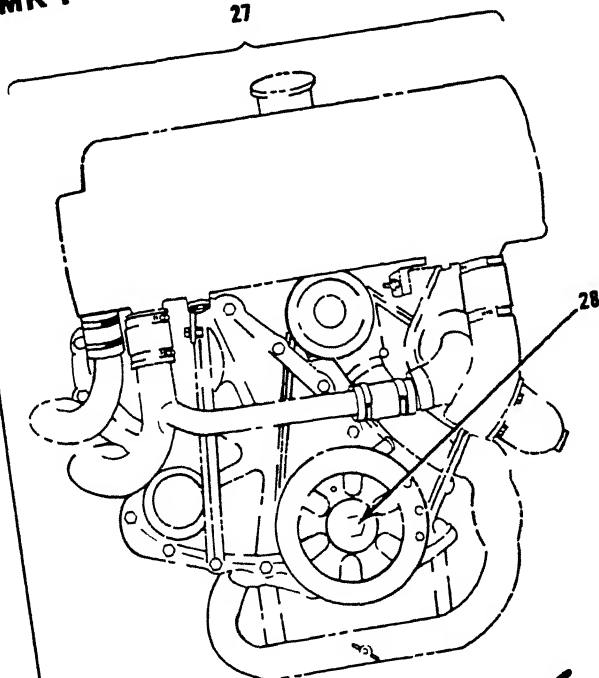
LOCATION	ITEM	ACTION	REMARKS
		e. Torque bolts evenly to 115-120 ft-lb (15.89 to 16.58 kg m).	Use 7/8 in socket and torque wrench. Check crankshaft rotation after tightening each cap.
	c. Crankshaft (22)	a. Move forward to take up end float.	
		b. Measure gap between crankshaft and forward thrust washer (21). Tolerance 0 002 - 0 010 in (0 051 - 0 254 mm)	Use feeler gage
10	Cylinder block (9)	a. Timing gear housing (1) and timing scale	Position on cylinder block face and secure with bolts
NOTE			
Follow steps 8a thru g, page 3-77, for installation of camshaft parts and timing gear housing cover			
11	Connecting rods (5)	a. Connecting rod bearings (8)	Lubricate Use clean engine oil
		b. Connecting rod (5)	Fit big end to crankshaft (journal) Rotate crankshaft as necessary

CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)



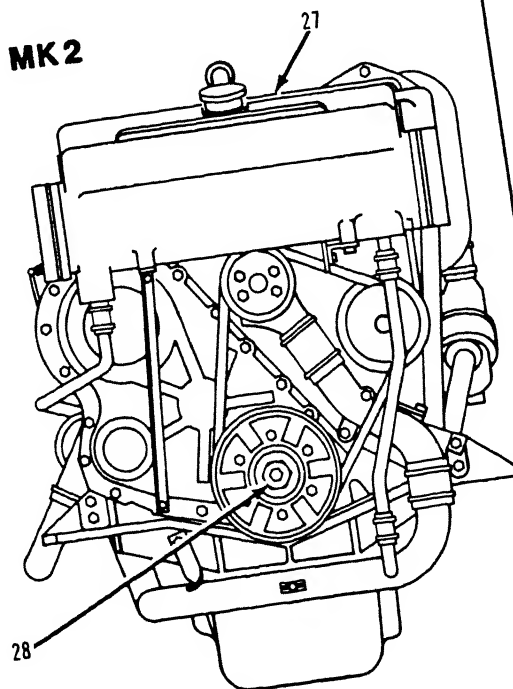
MK 1

27



MK 2

27



CRANKSHAFT INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)			
LOCATION	ITEM	ACTION	REMARKS
NOTE			
Make sure to mate bearing caps to original connecting arms from which disassembled.			
	c. Bearing caps (7) and bolts (6)	a In turn, position caps on connecting rod using dowels.	Use 5/8 in socket, 6 in extension and torque wrench (0 - 175 ft-lb)
		b Install bolts	
		c Torque bolts to 85 - 90 ft-lb (11 76 - 12 45 kg-m)	
12 Cylinder block (9)	Oil pump inlet pipe (10)	a Insert pipe into pump connection	
		b Screw in union (14), bend down lock tab (13)	Use 7/8 in open end wrench
		c Secure pipe bracket to main bearing cap (16) using cap screw (11) and washer (12)	Use 1/2 in socket and ratchet
13 Engine assembly (27)	Crankshaft pulley nut (28)	Check crankshaft rotation after tightening each bearing cap	Use 15/16 in socket and 3/4 in drive handle

CAMSHAFT AND CAMSHAFT BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS

This task covers

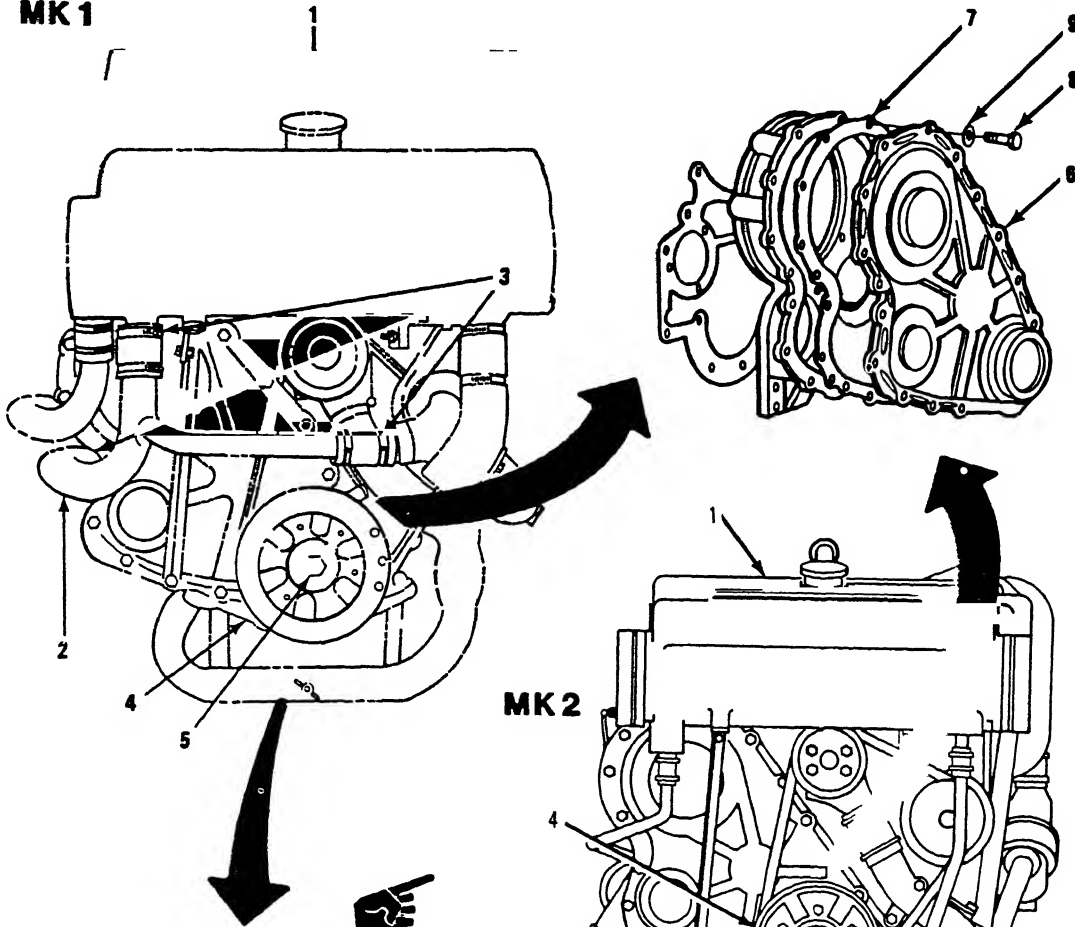
- | | |
|---------------|-----------------|
| a. Removal | c. Repair |
| b. Inspection | d. Installation |

INITIAL SETUP

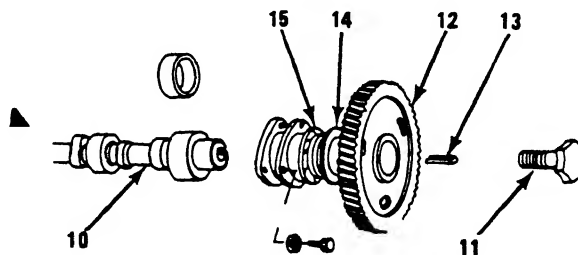
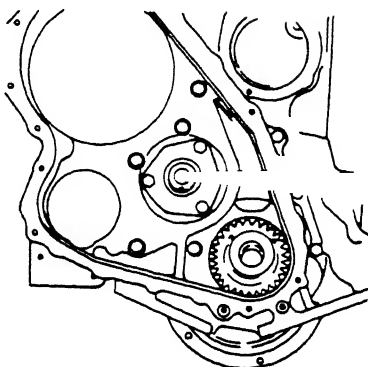
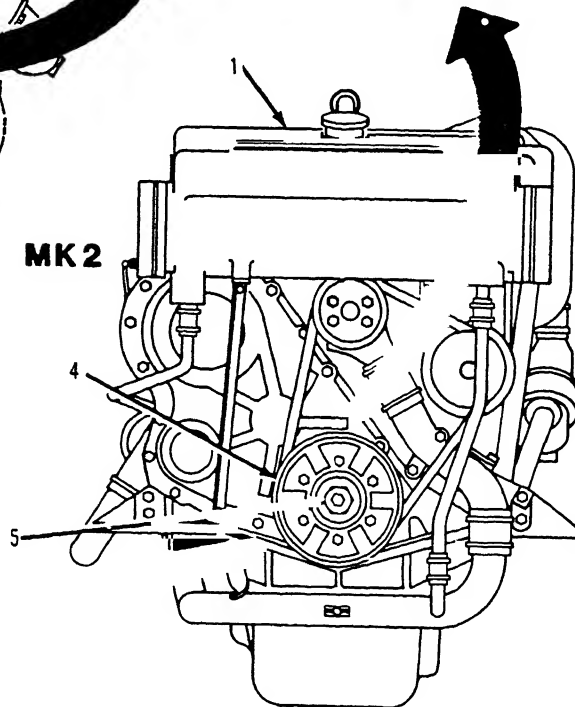
Tools	Equipment Condition:	Condition Description
Bearing puller	Page 2-179	Engine assembly removed from boat and mounted on engine maintenance stand or laid on side on top of work bench
Micrometer calipers, outside		
Micrometer calipers, inside		
Flat tip screwdriver, 6 inch		
15/16 in socket		
Hinged handle	TM 5-1940-277-20	Water pump and alternator belt removed
1/2 in socket		
Ratchet	TM 5-1940-277-20	Rocker arm assembly removed
1-7/8 in socket		
Gear puller	Page 2-307	Oil sump (pan) removed
9/16 in socket		
Torque wrench		
(0 - 600 ft-lb)	TM 5-1940-277-20	Drain cooling system
Brass drift		
Hammer, ball peen		
Torque wrench (0 - 175 ft-lb)		
Engine maintenance stand		
Materials/Parts		
Emery cloth, 240 grit		
Solvent		

CAMSHAFT AND CAMSHAFT BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

MK 1



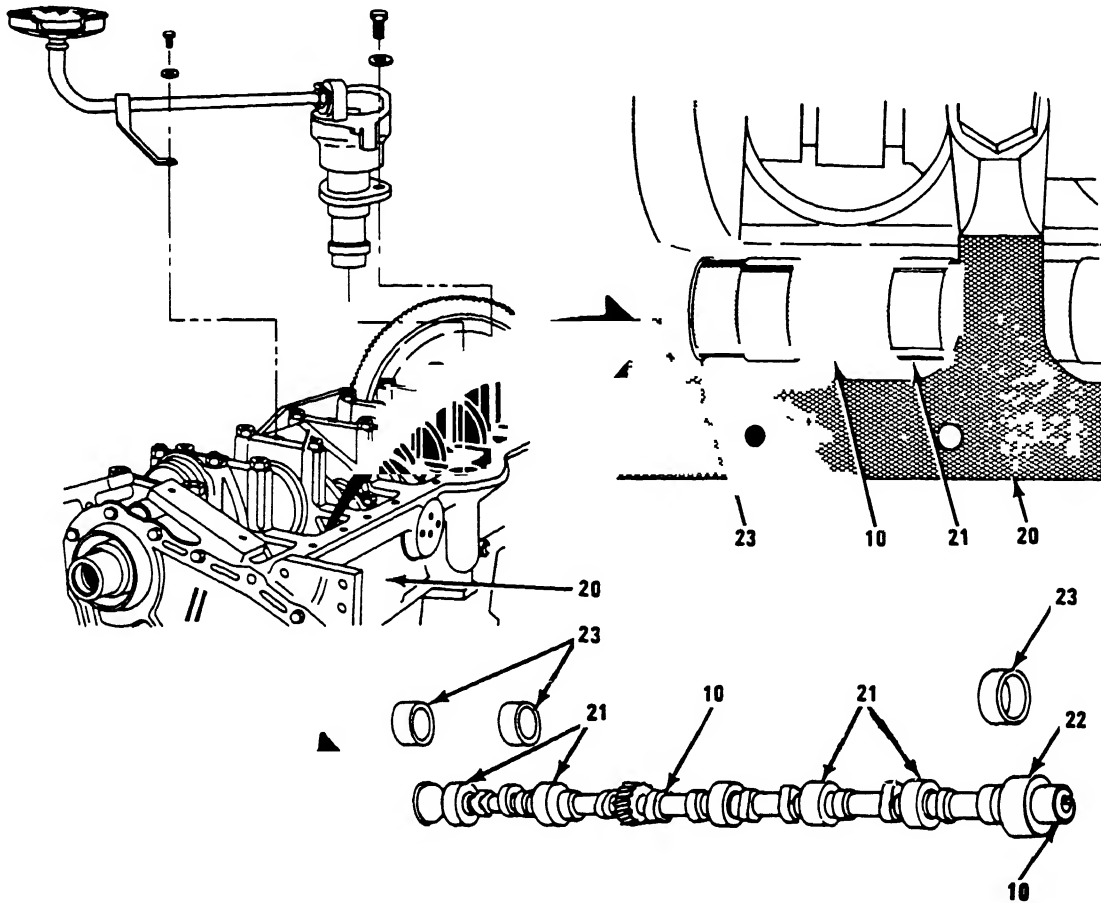
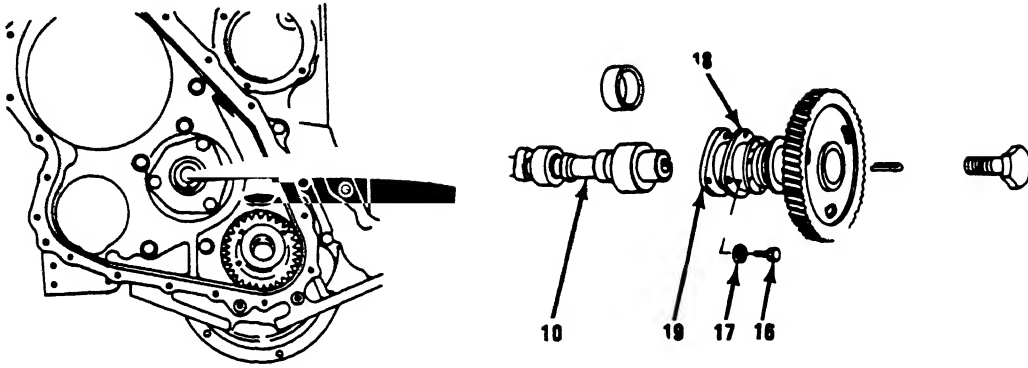
MK 2



CAMSHAFT AND CAMSHAFT BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>REMOVAL</u>			
1. Engine assembly (1)	a. Cooling pipe (2) between thermostat, engine oil cooler and header tank (MK1)	Loosen 3 clamps (3) and remove.	Use screwdriver.
	b. Crankshaft pulley (4) and bolt (5)	Remove	Use 15/16 in socket, hinged handle and gear puller
	c. Timing gear housing front cover (6), gasket (7), 19 bolts (8) and 19 washers (9)	Remove	Use 1/2 in socket and ratchet
2. Camshaft (10)	a. Bolt (11) and camshaft gear (12)	Remove bolt and pull gear off shaft	Use 1-7/8 in socket, hinged handle and gear puller
	b. Camshaft key (13)	Remove from shaft	
	c. Thrust washer (14) and collar (15)	Remove from shaft and discard	

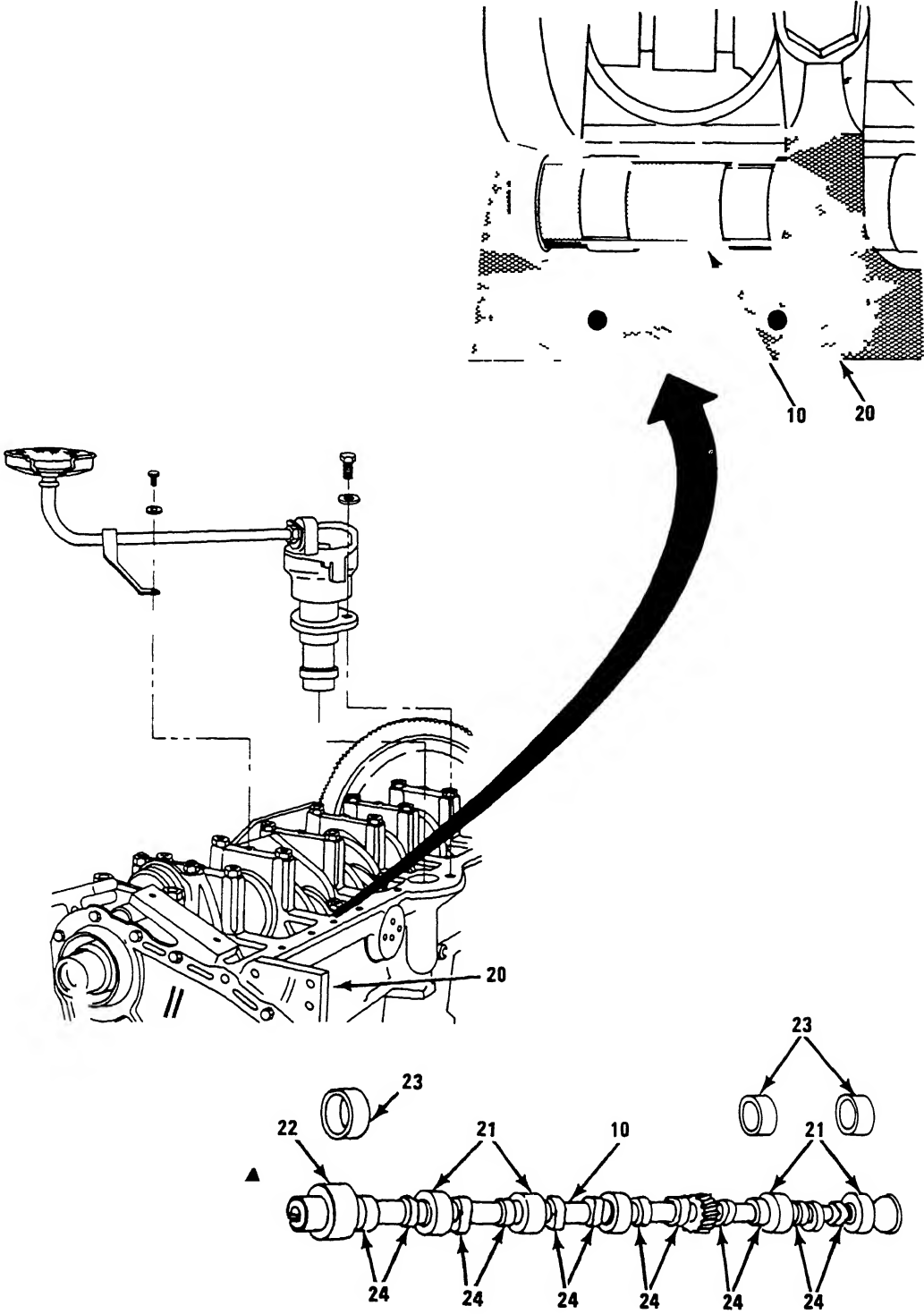
CAMSHAFT AND CAMSHAFT BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



CAMSHAFT AND CAMSHAFT BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
	d. 3 bolts (16), 3 washers (17), locking plate (18) and thrust plate (19)	Remove	Use 9/16 in socket and ratchet
	e. Camshaft (10)	Withdraw from cylinder block (20)	Take care not to damage bearings with cam lobes
<u>INSPECTION</u>			
3	Camshaft (10)	Measure diameter of all bearing journals (21) and (22)	Use micrometer calipers, outside
4	Cylinder block (20)	Camshaft bearings (23)	Use micrometer calipers, inside
		a Measure inside diameter of bearings	
		b Determine camshaft to bearing clearance, (diameter of step 4a minus diameter of step 3), compare to specification	
		Front (24) - 0 0015 to 0 0025 in (0 038 to 0 063 mm)	
		Rear and Intermediate (23) - 0 001 to 0 002 in (0 025 to 0 051 mm)	

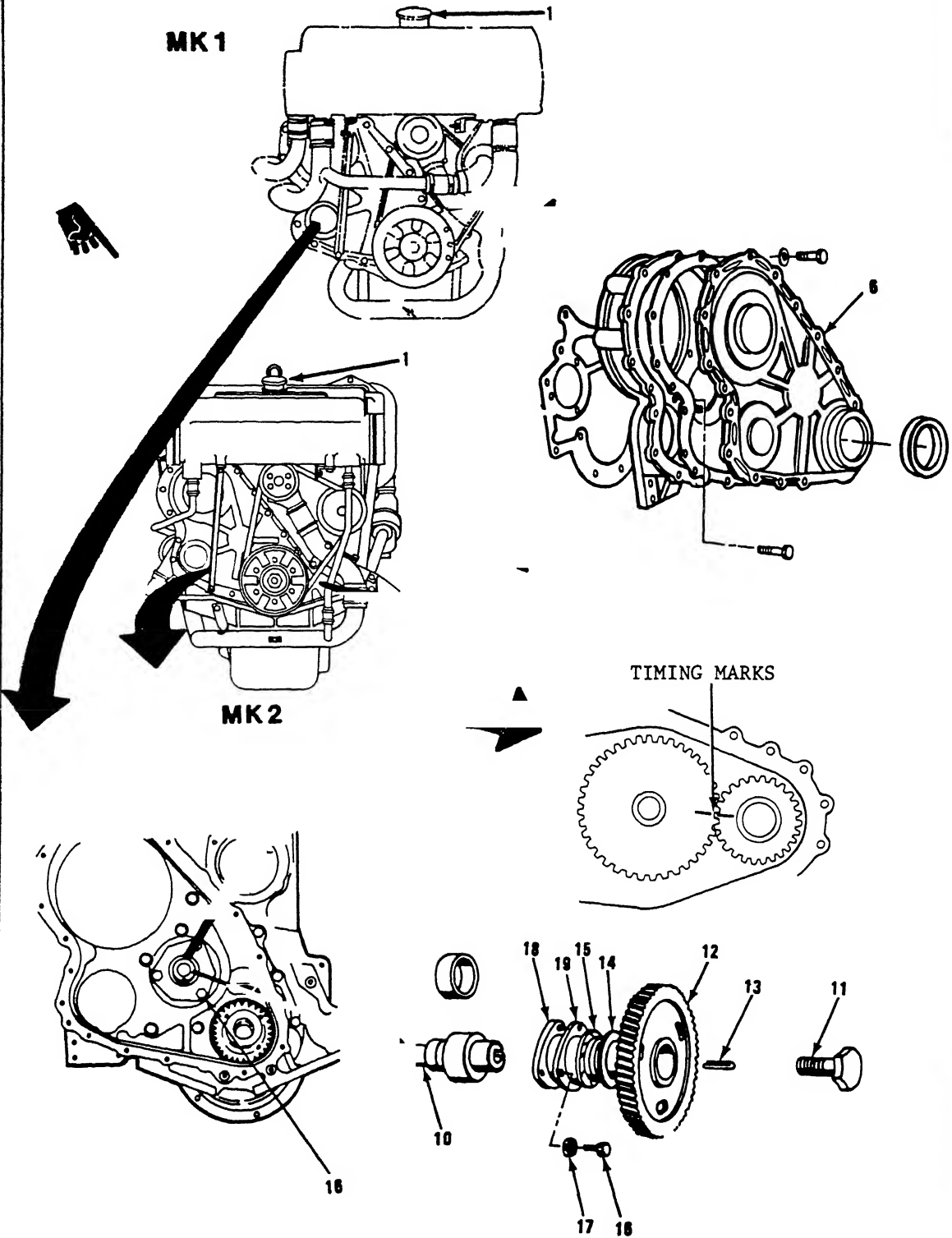
CAMSHAFT AND CAMSHAFT BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



CAMSHAFT AND CAMSHAFT BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
		c Replace all bearings if any are outside of limits.	Use bearing puller
5	Camshaft (10)	Camshaft lobes (24) and bearing journals (21) and (22)	a. Inspect for Scoring and Flat spots
		b Replace camshaft if damaged	Replace bearings at same time
<u>INSTALLATION</u>			
6	Cylinder block (20)	a Camshaft bearings (23)	a Clean preservative off new bearings
		b Press into place	Use bearing puller-pusher
		b Camshaft (10)	a Clean preservative off new camshaft
		b Insert camshaft into cylinder block	Use solvent
			Be careful not to damage bearings or edges of lobes and journals

CAMSHAFT AND CAMSHAFT BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

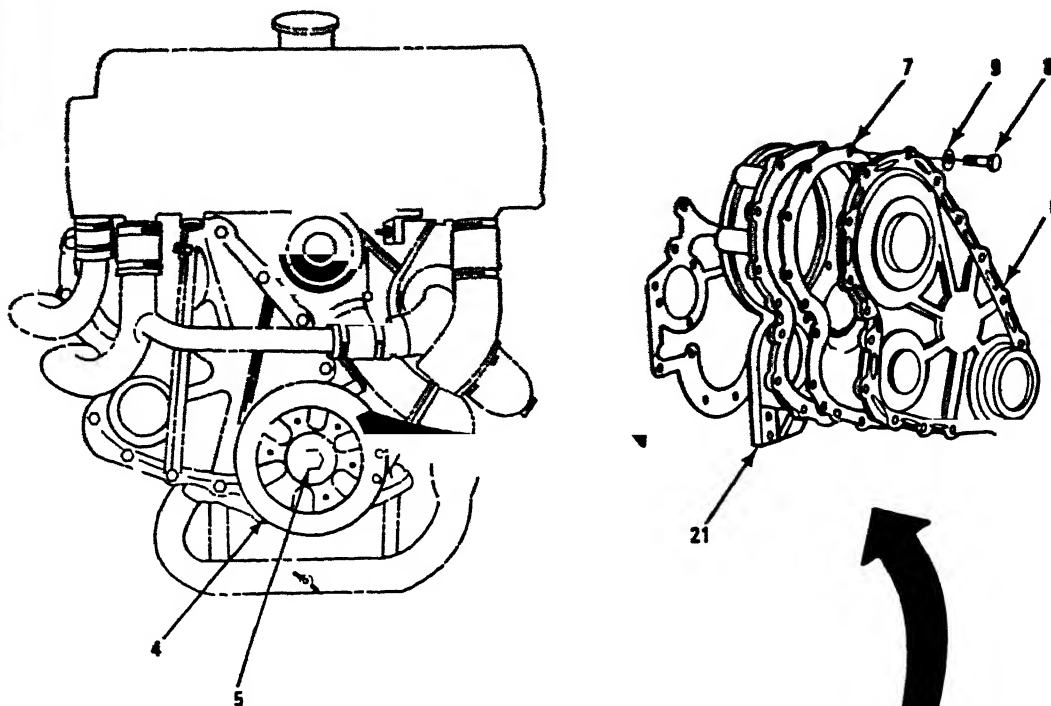


CAMSHAFT AND CAMSHAFT BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

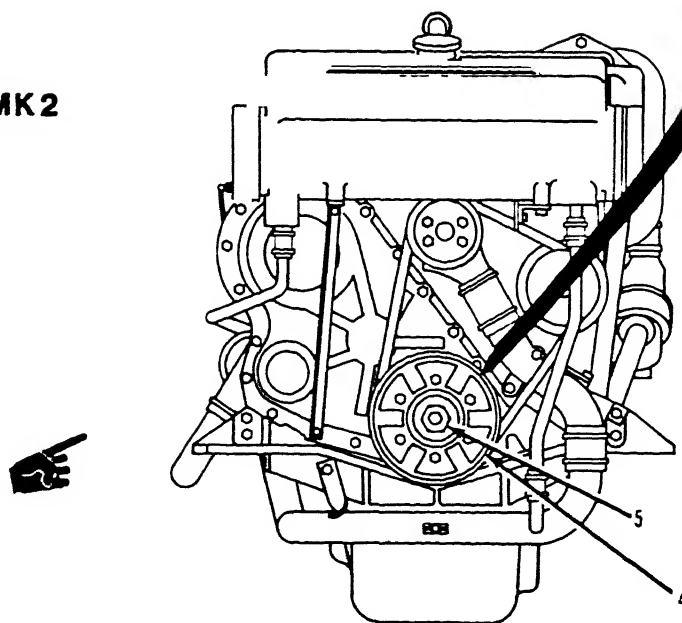
LOCATION	ITEM	ACTION	REMARKS
7. Engine assembly (1)	a. Camshaft thrust plate (18), locking plate (19), 3 bolts (16) and 3 washers (17)	Torque bolts, 30 ft-lb (4.15 kg-m) evenly in sequence (see figure).	Use 9/16 in socket and torque wrench.
	b. Camshaft thrust washer (14), collar (15) and key (13)	Install on end of camshaft.	Make sure grooved face of washer is next to thrust plate
	c. Camshaft gear (12)	a. Aline camshaft and crankshaft timing marks (see figure).	
		b. Drive gear onto camshaft	Use brass drift and hammer
	d. Camshaft bolt (11)	Screw in camshaft bolt Torque to 150 - 155 ft-lb (20.74 to 21.43 kgfm)	Use 15/16 in socket and torque wrench
	e. Timing gear housing front cover (6)	a. Inspect cover around oil seal for cracks Replace cover if any cracks are present	
		b. Remove old oil seal	Be careful not to distort cover

CAMSHAFT AND CAMSHAFT BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

MK1



MK2



CAMSHAFT AND CAMSHAFT BEARING INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		c Fit new oil seal with seal lip toward inside of cover	
		d Fit gasket (7) and cover (6) to housing (21)	
NOTE			
A bolt tightening sequence for cover bolts is not required			
		e Install 19 washers (9) and bolts (8)	Use 1/2 in socket and ratchet
	f Crankshaft pulley (4)	Fit onto crankshaft	
	g Crankshaft nose bolt (5)	Screw in Torque to 240 ft-lb (33 20 kgfm)	Use 15/16 in socket and torque wrench



ENGINE BLOCK INSPECTION AND REPLACEMENT INSTRUCTIONS

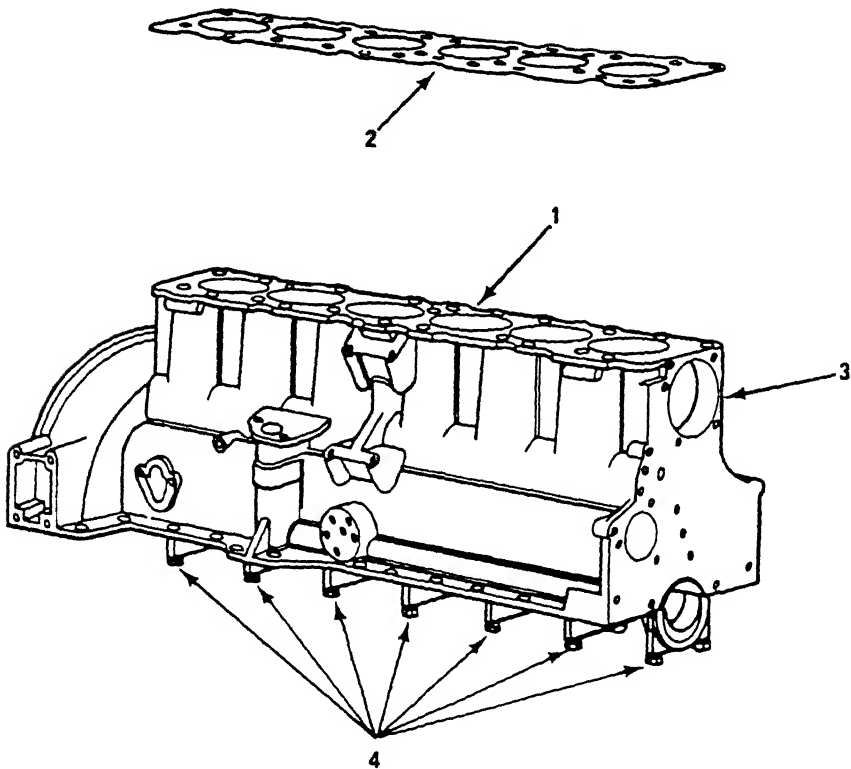
This task covers

- a. Inspection
- b. Replacement

INITIAL SETUP

Tools	Equipment Condition	Condition Description
Ratchet	Page 3-75	Camshaft removed
Torque wrench, (0 - 175 ft-lb)	Page 3-75	Crankshaft removed
7/8 in socket	Page 2-291	Cylinder head assembly removed
3/4 in socket	Page 3-29	Pistons and connecting rod assemblies removed
1/2 in socket		Starter removed
Air compressor	TM 5-1940-277-20	Alternator removed
Air blow gun	TM 5-1940-277-20	Water pump removed
Hoist	TM 5-1940-277-20	Engine oil cooler removed
Immersion tank	TM 5-1940-277-20	Fuel lift pump removed
Steel straightedge		Engine oil pressure sender removed
Feeler gage	TM 5-1940-277-20	Tachometer and drive removed
1/2 in UNC-3A thread cutting die	TM 5-1940-277-20	
Safety goggles	TM 5-1940-277-20	
Dial indicator		
File		
Micrometer caliper, inside		
Electric drill, 3/8 in		
Materials/Parts		
Cylinder head gasket		
Engine oil		

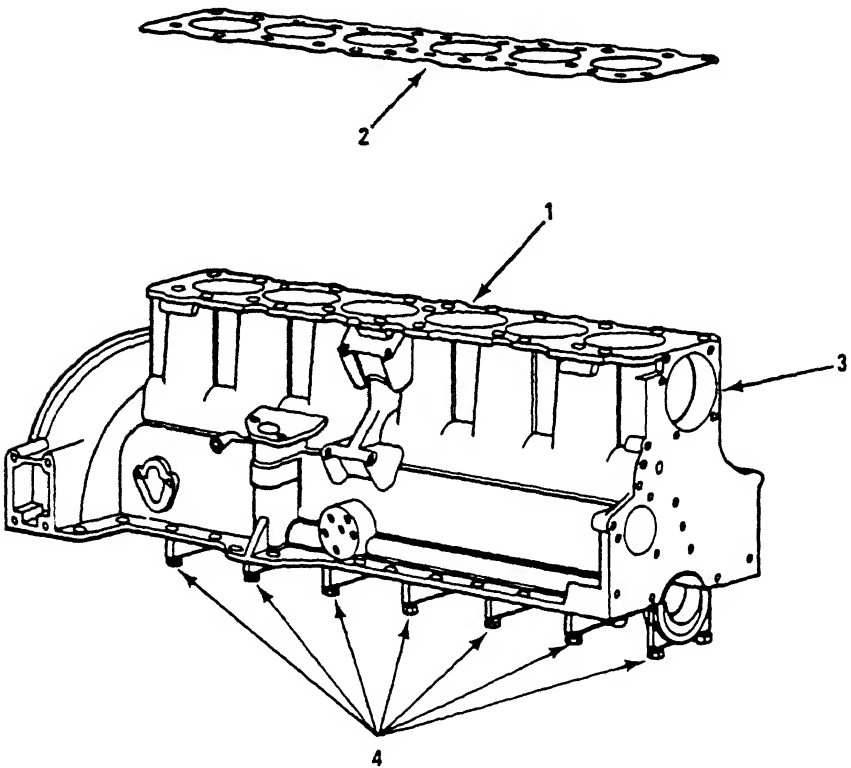
ENGINE BLOCK INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE BLOCK INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
NOTE			
The cylinder block assembly consists of the cast cylinder block with the integrally cast upper half of the crankcase and the seven main bearing caps			
<u>INSPECTION AND REPLACEMENT</u>			
Cylinder block (1)	a Cylinder block (1)	a Pressure test for cracks as follows <ul style="list-style-type: none"> • Fit new head gasket (2) • Install 1/2 in thick steel plate on top of cylinder block (1) • Install 25 bolts with washers to secure steel plate, torque bolts to 135 ft-lb • Install suitable cover with air hose connection and new gasket over water pump hole (3) in front face of block • Attach air hose to water pump hole cover 	Head gasket can be used as pattern for boring bolt holes Use torque wrench (0 - 175 ft-lb cap) with 3/4 in socket Use 1/2 in socket with torque wrench (0 - 175 ft-lb) Secure cover using four 5/16 in UNC bolts Torque to 15 ft-lb

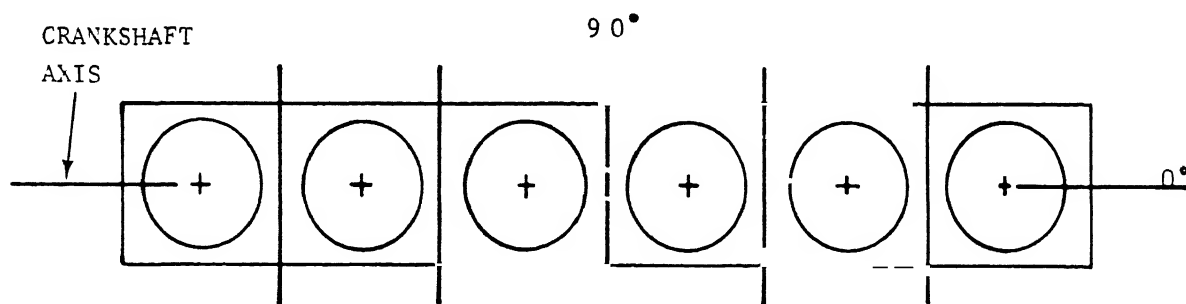
ENGINE BLOCK INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE BLOCK INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		<ul style="list-style-type: none"> Place block in immersion tank of water, heated to 180 - 212° F for 20 minutes 	Use hoist to lift.
<p style="text-align: center;"><u>WARNING</u></p> <p>Always use safety goggles when using dry compressed air pressure can cause injury and cut the skin</p>			
		<ul style="list-style-type: none"> After 20 minute immersion period apply 80 - 100 psi air pressure to block Check for air bubbles leaking from cylinder block (indication of cracks in block) Release air pressure and remove block from immersion tank Remove cover over water pump hole (3) and 1/2 in steel plate and gasket (2) on top of block 	Use air compressor

ENGINE BLOCK INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

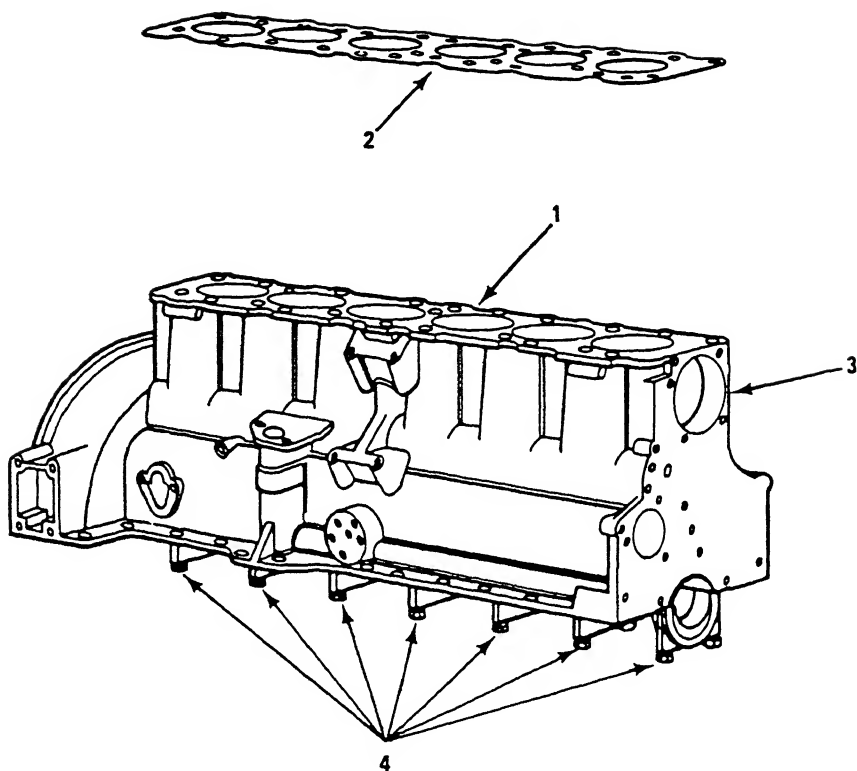


MEASUREMENT POINTS FOR ENGINE BLOCK WARPAGE

ENGINE BLOCK INSPECTION AND REPLACEMENT INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>WARNING</u>			
Always use safety goggles when using dry compressed air. Do not use pressures greater than 30 psi. High air pressure can cause injury and cut the skin.			
		<ul style="list-style-type: none"> • Dry cylinder block and liner using compressed air • Coat cylinder liner with oil to prevent rust 	Use air compressor with air gun
		b Inspect block for warpage parallel to length of crankshaft and at 90° to crankshaft axis (short axis) at each cylinder	Use steel straightedge and feeler gage
		Warpage limit 0.004 in except the warpage limit for 3 and 4 cylinder the short axis in vicinity of water bore number 3 and 4 cylinder is 0.002 in due to water bore arrangement	Lower warpage limit in vicinity of number 3 and 4 cylinders is due to water bore arrangement

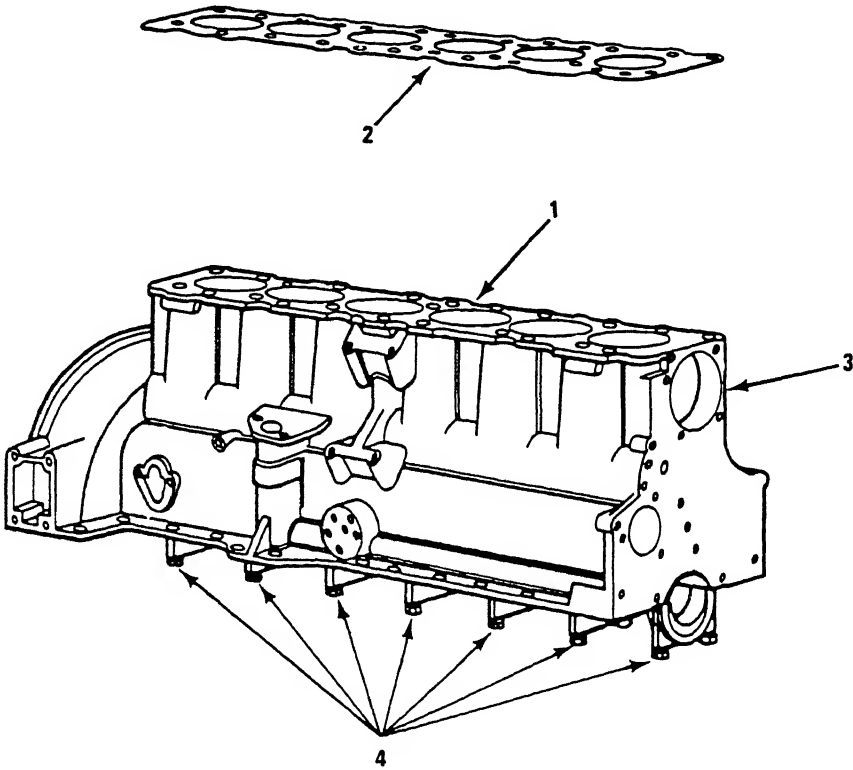
ENGINE BLOCK INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE BLOCK INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		c Inspect all threaded holes for cross threading	Use 1/2 in UNC-3A thread cutting die if bolt holes need retapping Full thread depth is 1 in (25 mm)
		d Replace block if <ul style="list-style-type: none"> • Warped beyond limits • Cracked 	
	b Main bearing caps (4)	a Inspect cap alinement <ul style="list-style-type: none"> • Install 7 main bearing caps and 14 cap bolts, torque bolts to 115 - 120 ft-lb • Measure main bearing bores, limit 3 1665 to 3 1673 in • Remove main bearing caps and install lower main bearing halves into caps • Install upper main bearing halves into cylinder block 	Use 7/8 in socket and torque wrench (0 - 175 ft-lb) Use micrometer caliper, inside Make sure locating tongues engage in locating grooves The center and rear lower bearing halves have oil grooves Make sure locating tongues engage in locating grooves Upper bearing halves have oil feed hole and oil groove

ENGINE BLOCK INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)



ENGINE BLOCK INSPECTION AND REPLACEMENT INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		<ul style="list-style-type: none"> • Lubricate bearing halves. • Install crankshaft. • Reinstall main bearing caps and bolts. Torque to 115 - 120 ft-lb. • Rotate crankshaft. 	<p>Use clean engine oil.</p> <p>Binding crankshaft indicates main bearing caps are out-of-line longitudinally and that one or more of the caps are defective</p>
		<p>b If bearing caps are defective replace engine block</p>	

TRANSMISSION REPAIR INSTRUCTIONS

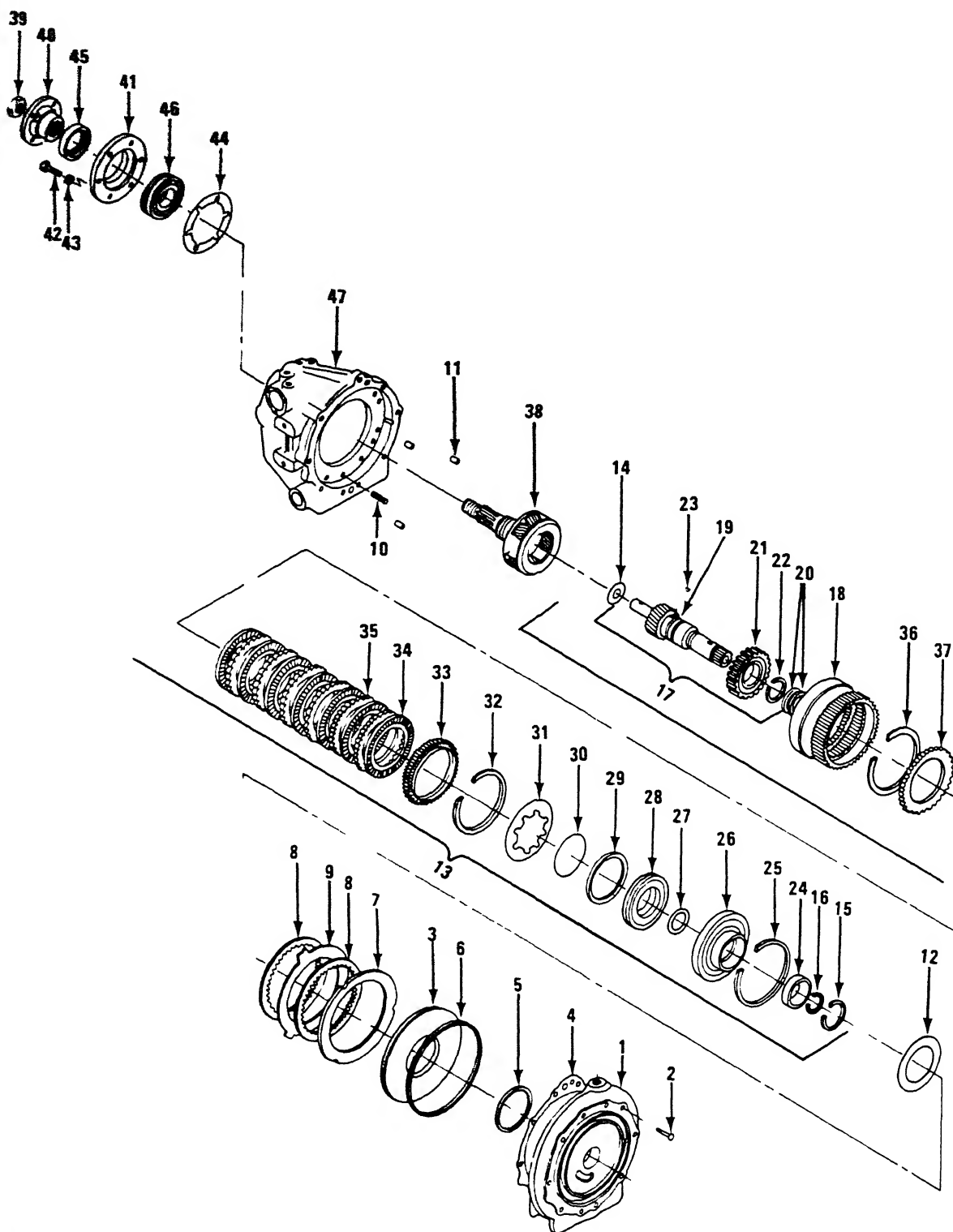
This task covers

- a Disassembly
- b Inspection
- c Assembly

INITIAL SETUP

Tools	Equipment Condition	Condition Description
3/8 in socket, thin wall Ratchet	Page 2-345	Transmission removed from engine
5/8 in socket	Page 2-307	Oil pump removed
Gear puller	Page 2-327	Control valve removed
Arbor press with attachments		
Non-metallic hammer		
1-1/2 in socket Ratchet		
Torque wrench (0 - 175 ft-lb)		
Bearing puller		
Snap ring pliers		
Air blow gun		
Small flat tip screwdriver		
Flat tip screwdriver, 6 inch		
Pliers		
Safety goggles		
Bearing assembly tools C1 and C2		
Feeler gage		
Materials/Parts		
Gaskets		
Engine oil		
O-rings		
Seals		
Petroleum jelly		
Clutch spring bearing ring		
Silicone sealant		
Padding		
Snap ring, selective package		

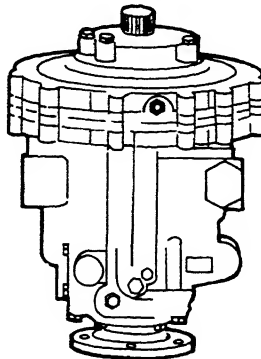
TRANSMISSION REPAIR INSTRUCTIONS (Continued)



TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY

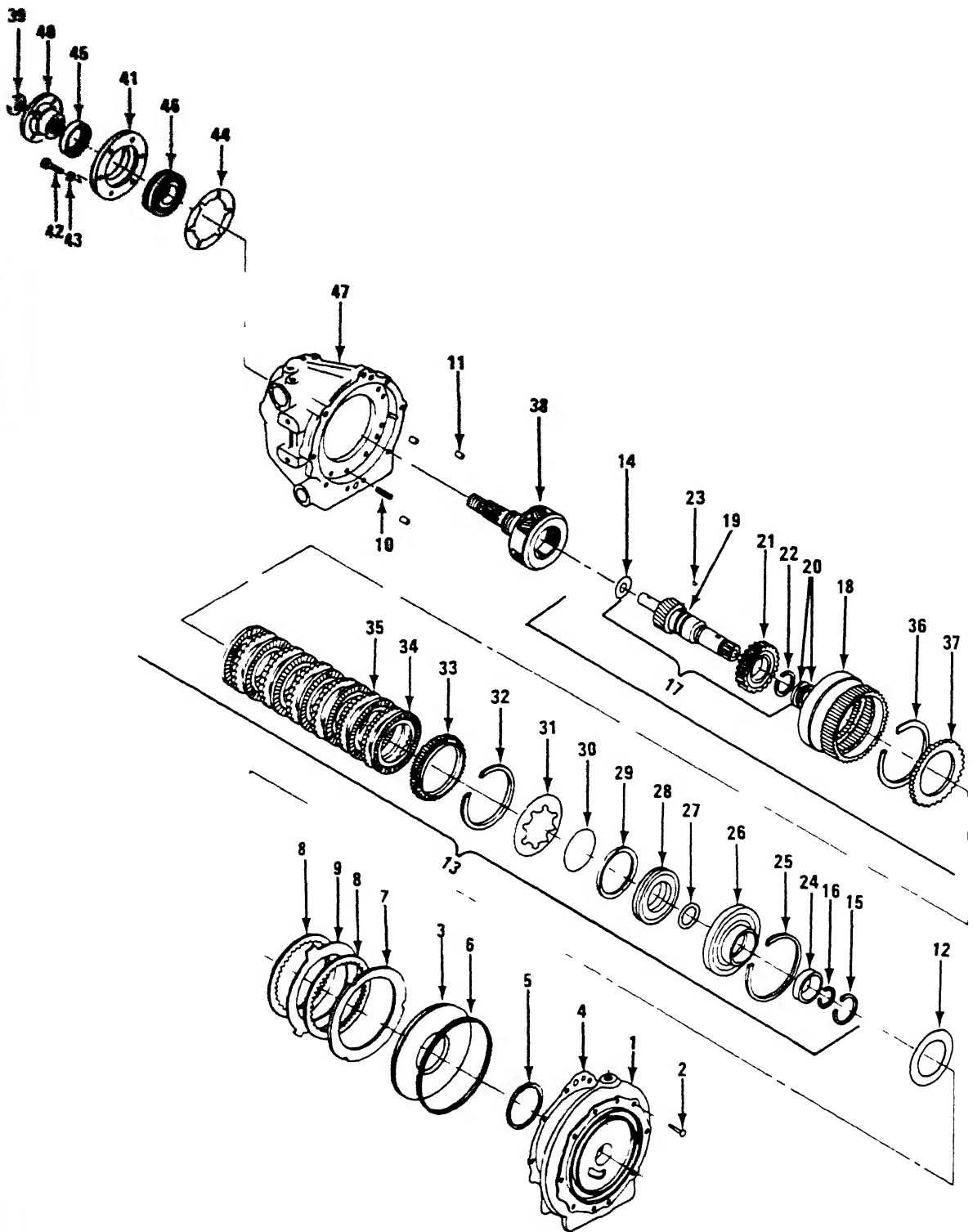


NOTE

Start procedure with transmission standing on coupling with adapter upward

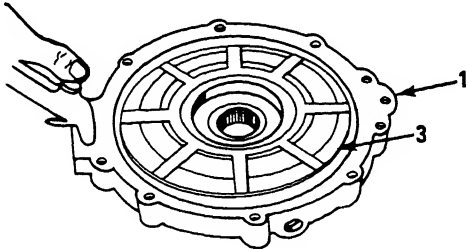
- | | | | | |
|---|------------------------|---|--|--|
| 1 | Adapter (1) | 4 cap screws (2) | Remove | Use 3/8 in thin wall socket with ratchet |
| 2 | Transmission case (47) | a Adapter (1) and reverse clutch piston (3) | Lift adapter and reverse clutch piston as a unit | Tap adapter with non-metallic hammer if necessary. The reverse clutch plate (8) may momentarily stick to the reverse clutch piston (3) DO NOT ALLOW IT TO DROP |
| | | b Adapter gasket (4) | Remove and discard | |

TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

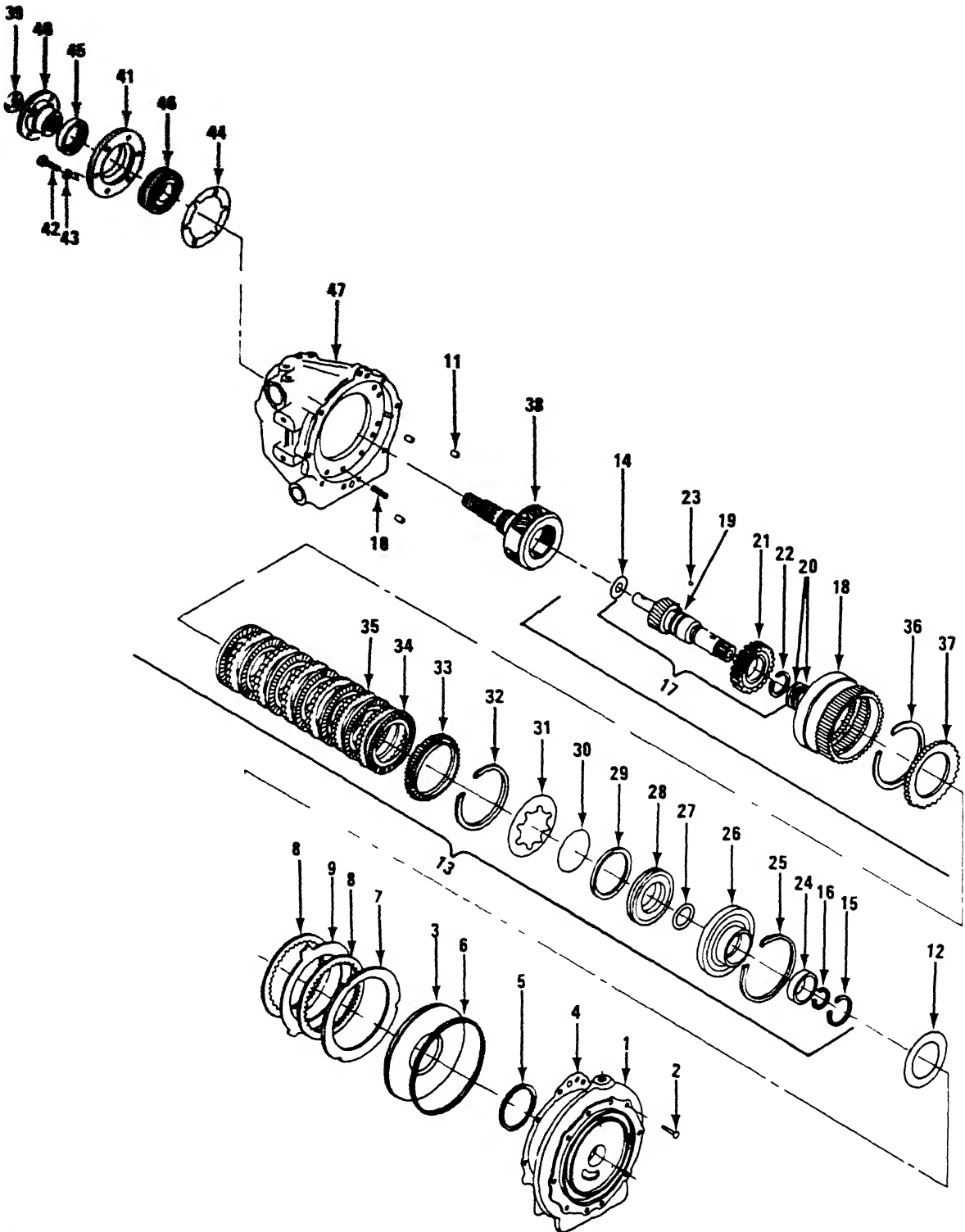


TRANSMISSION REPAIR INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
<p style="text-align: center;"><u>WARNING</u></p> <p>Always use safety goggles when using dry compressed air. Do not use pressures greater than 30 psi. High air pressure can cause injury and cut the skin.</p>			
			
3	Adapter (1)	<p>a. Reverse clutch piston (3)</p> <p>b. Remove.</p>	<p>a Force compressed air into the large oil passage hole at either top or bottom of adapter</p> <p>b. Remove.</p>
	b Sealing ring (5)	Remove and discard	Use small screwdriver
4	Reverse clutch piston (3)	Sealing ring (6)	Remove from piston outer diameter and discard
			Use small screwdriver

TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



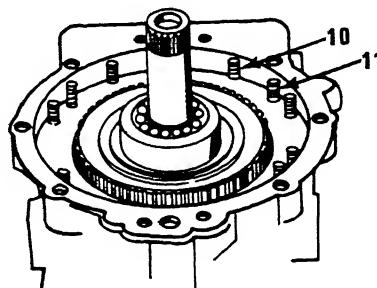
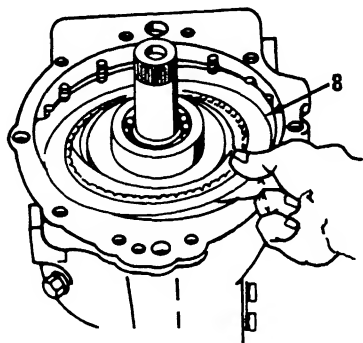
TRANSMISSION REPAIR INSTRUCTIONS (Continued)

LOCATION

ITEM

ACTION

REMARKS



5 Transmission case (47)

a Clutch pressure plate (7)

Remove.

Use hands

b Reverse clutch plate (8)

Remove

Use hands

c Outer clutch plate (9)

Remove

Use hands

d Reverse clutch plate (8)

Remove

Use hands

e. 12 pressure plate springs (10)

Remove

Use hands

f 3 dowel pins (11)

Remove

Use fingers

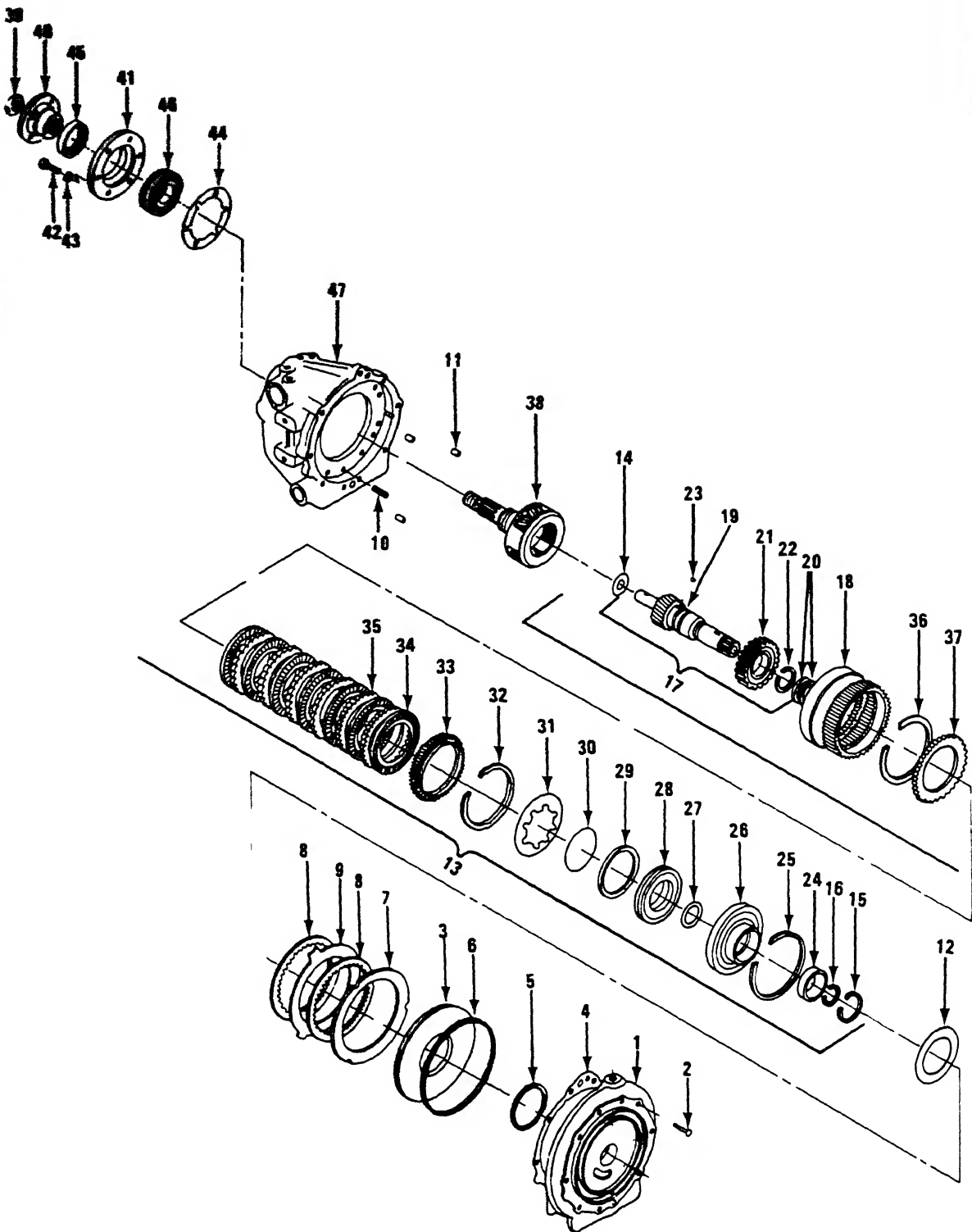
g Thrust washer (12)

Remove from forward clutch cylinder (26).

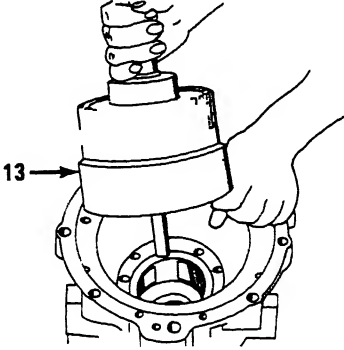
Use fingers.

TRANSMISSION REPAIR INSTRUCTIONS

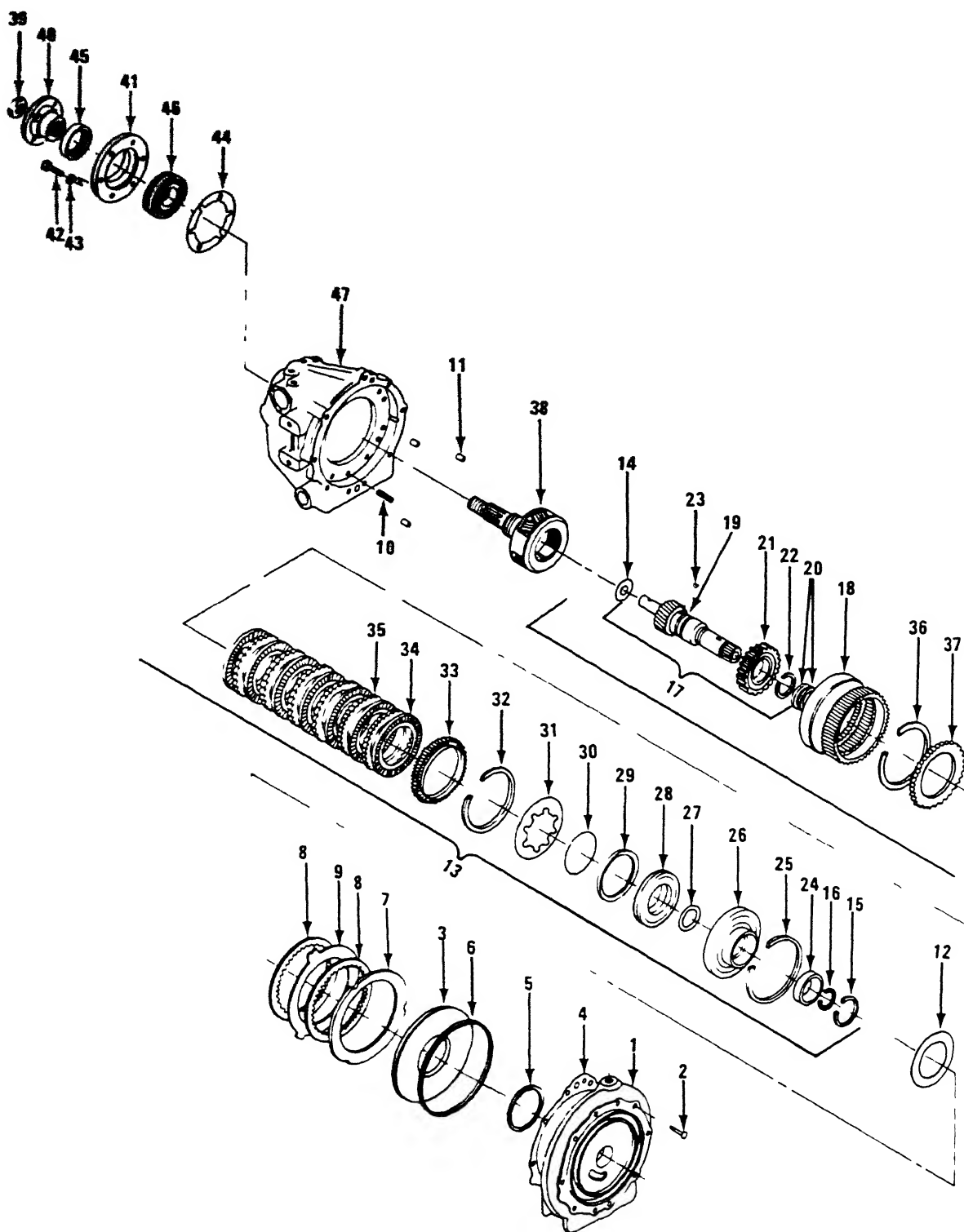
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
			
	h Ring gear subassembly (13)	a Remove from transmission by lifting straight up	Grasp exposed front end of drive gear (shaft) and lift. Assembly should come out easily.
		b Carry assembly to work bench in preparation for disassembly	
	i Thrust washer (14)	Remove washer located between drive gear (19) and planetary carrier (38)	Use fingers
<p>NOTE</p> <p>The ring gear subassembly must be placed in a suitable fixture with ball bearing end up before further disassembly is attempted</p>			
6	Ring gear subassembly (13)	a Internal snap ring (15)	Remove Use snap ring pliers.

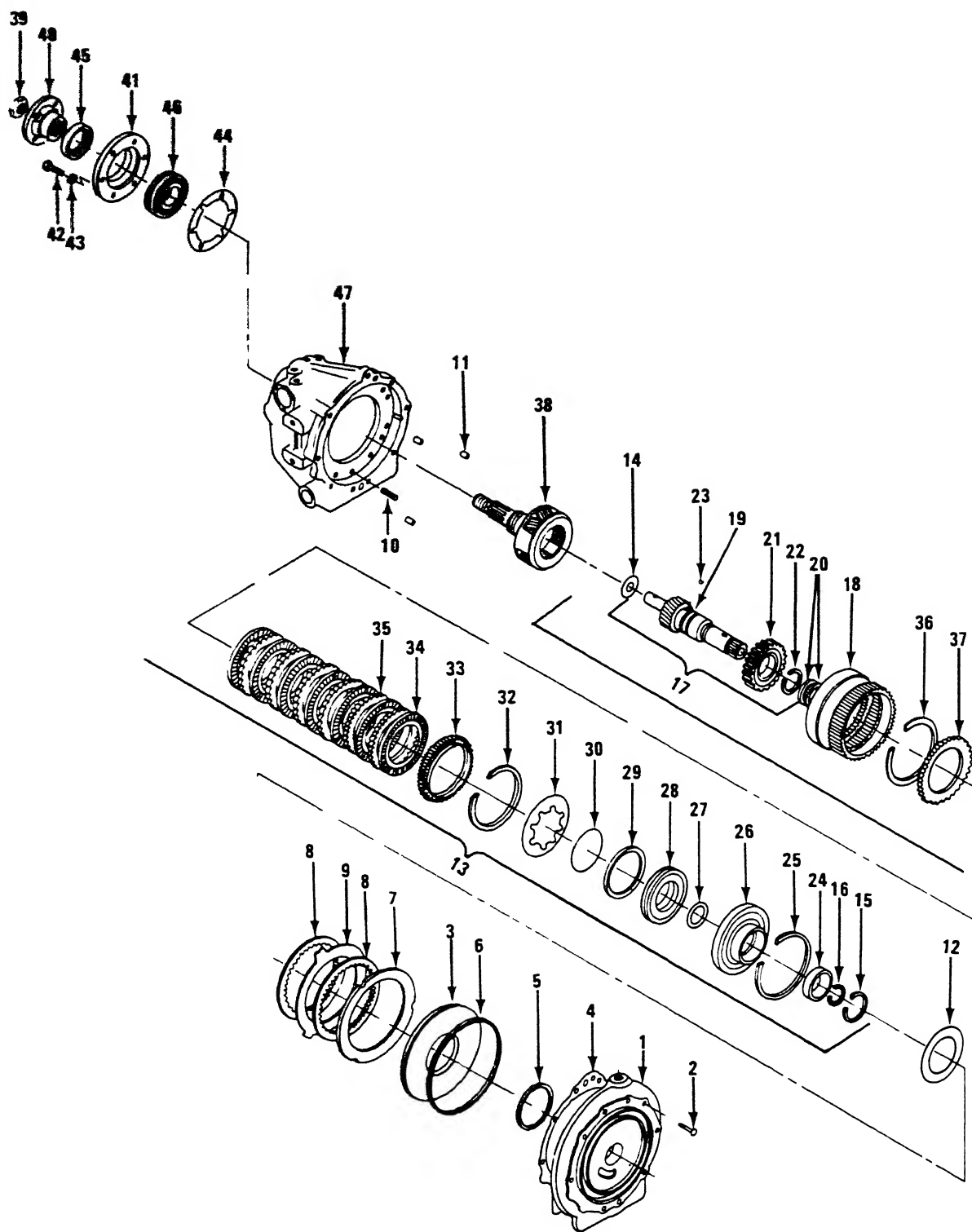
TRANSMISSION REPAIR INSTRUCTIONS (Continued)



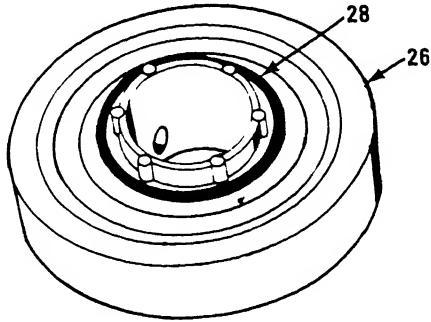
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	b. External snap ring (16)	Remove.	Use snap ring pliers DO NOT ALLOW DRIVE GEAR TO MOVE FORWARD AFTER SNAP RING REMOVED.
	c. Drive gear and forward clutch hub assembly (17)	a Hold ring gear (18) and tap front end of drive gear shaft (19) with non-metallic hammer b Remove	Use non-metallic hammer Assembly will pass through ring gear and forward clutch assembly to come out rear end of ring gear.
7 Drive gear shaft (19)	a 2 sealing rings (20)	Remove and discard	Use small screw-driver
	b Snap ring (21)	Remove	Use snap ring pliers
	c Forward clutch hub (22)	Remove by pulling off	Use gear puller
	d Woodruff key (23)	Remove	Use fingers or pliers if stuck
8. Ring gear (18)	a Bearing (24)	Remove from clutch cylinder (26) by tapping with non-metallic hammer.	Use non-metallic hammer

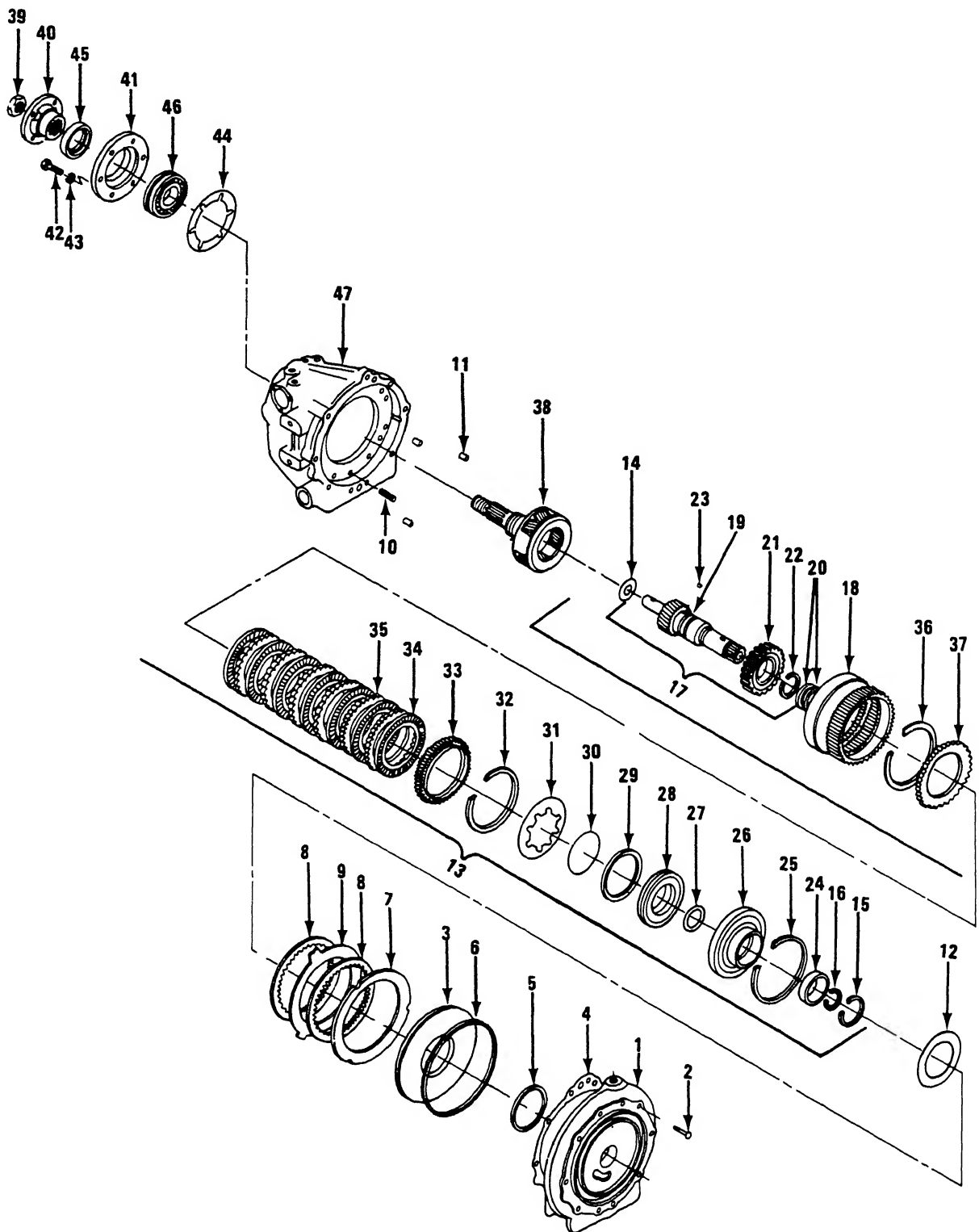
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



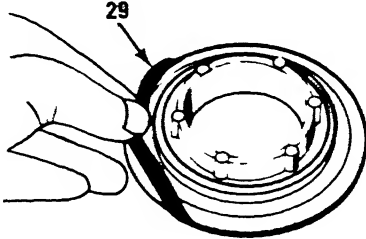
TRANSMISSION REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
	b. Ring gear snap ring (25)	Remove.	Use pliers or screwdriver
	c. Forward clutch cylinder (26)	Hold ring gear and tap exposed face of forward clutch cylinder with soft ham- mer. Cylinder will move forward and can be removed.	Use non-metallic hammer.
<p style="text-align: center;"><u>WARNING</u></p> <p>Always use safety goggles when using dry compressed air. Do not use pressures greater than 30 psi. High air pressure can cause injury and cut the skin.</p>			
			
9 Forward clutch cylinder (26)	a Forward clutch piston (28)	a Apply com- pressed air through one of three holes in inside dia- meter of for- ward clutch cylinder (26) while other holes are blocked.	Use air blow gun Hold fingers over two holes. Pis- ton will be blown out of cylinder.

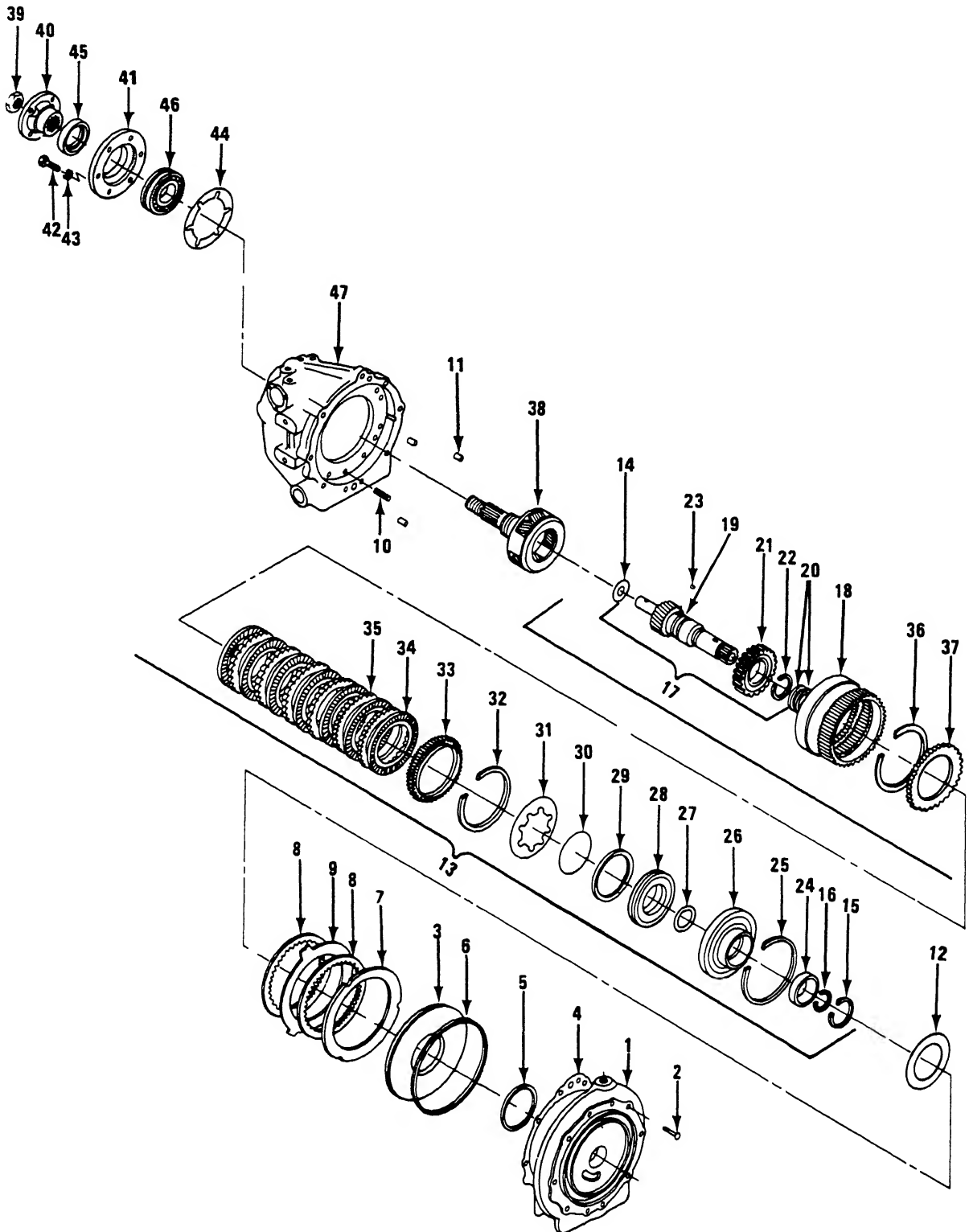
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. Remove.	
	b. Sealing ring (27)	Remove from forward clutch cylinder cavity and discard.	Use small screwdriver.
			
10 Forward clutch piston (28)	a Sealing ring (29)	Remove from diameter of piston and discard	Use small screwdriver
	b Clutch spring bearing ring (30)	Remove from race of piston and discard	Use small screwdriver
11 Ring gear (18)	a Clutch spring (31)	Remove	Use hands
	b Clutch spring snap ring (32)	Remove	Use screwdriver Ring is not located in a groove
	c Clutch pressure plate (front) (33)	Remove	Use hands

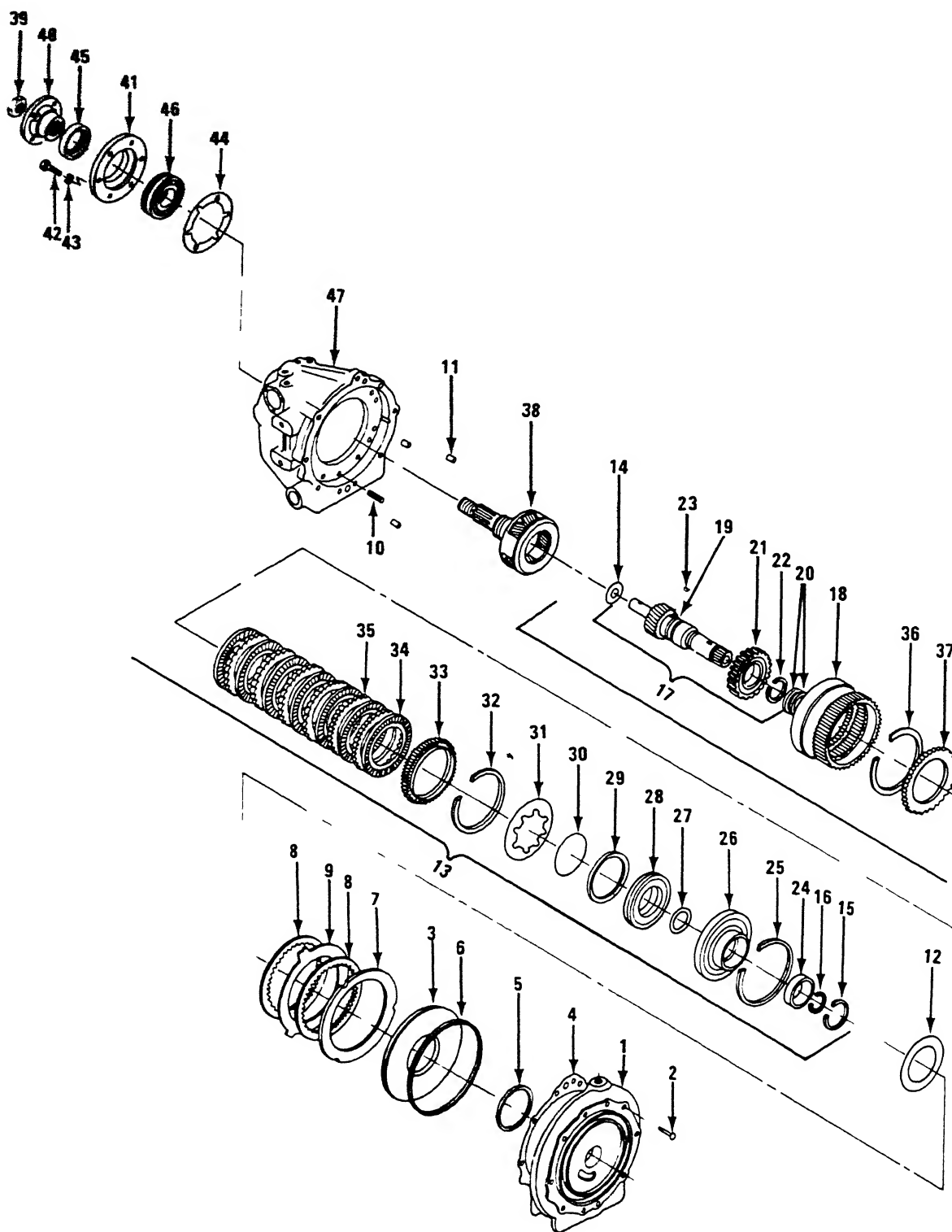
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS
 (Continued)

LOCATION	ITEM	ACTION	REMARKS
	d. 7 clutch inner plates (34) and 6 clutch outer plates (35)	Remove	Use hands.
	e Pressure plate (rear) (36)	Remove	Use hands
	f Snap ring selective (37)	Remove	Use screwdriver
NOTE			
Transmission coupling (40) must be clamped in vise for next step			
12 Pinion cage and output shaft (38)	a Main shaft nut (39)	Remove	Use 1-1/2 in socket and ratchet
NOTE			
Remove coupling from vise and place transmission case (47) on face to continue procedures			
	b Coupling (40)	Pull from shaft	Use bearing puller
13 Bearing retainer (41)	6 bolts (42) and lockwashers (43)	Remove	Use 5/8 in socket with ratchet
14 Transmission case (47)	Bearing retainer (41) and gasket (44)	a Remove b Discard gasket	

TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
15. Bearing retainer (41)	Seal (45)	Remove.	Use seal puller.
<p style="text-align: center;"><u>CAUTION</u></p> <p>Before performing next step place cushioning material under transmission case for pinion cage and output shaft (38) to fall on when pushed out.</p>			
16. Pinion cage and output shaft (38)	Annular bearing (46)	Push shaft out of bearing	Use bearing puller to grasp bearing by ex- posed groove in outside diameter Pinion cage and output shaft will be pushed out of bearing
17 Transmission case (47)	Annular bearing (46)	Remove from case	Case may have to be turned and bearing tapped gently with ham- mer handle to loosen

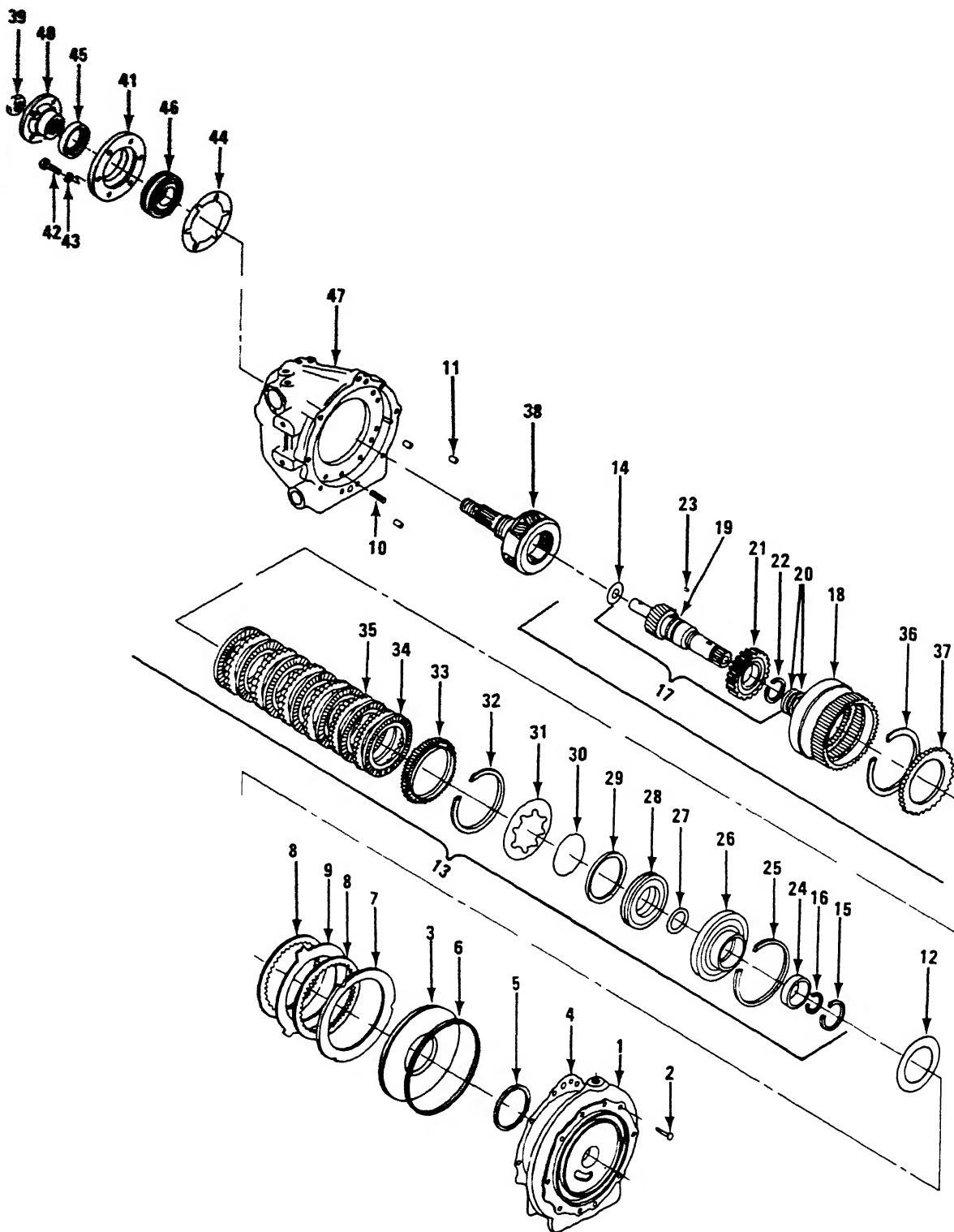
NOTE

Lift transmission case (47) from pinion cage and output shaft (38) and place on base

INSPECTION

18	Bearings	a Visually inspect for Chips, Cracks, or Discoloration
----	----------	---

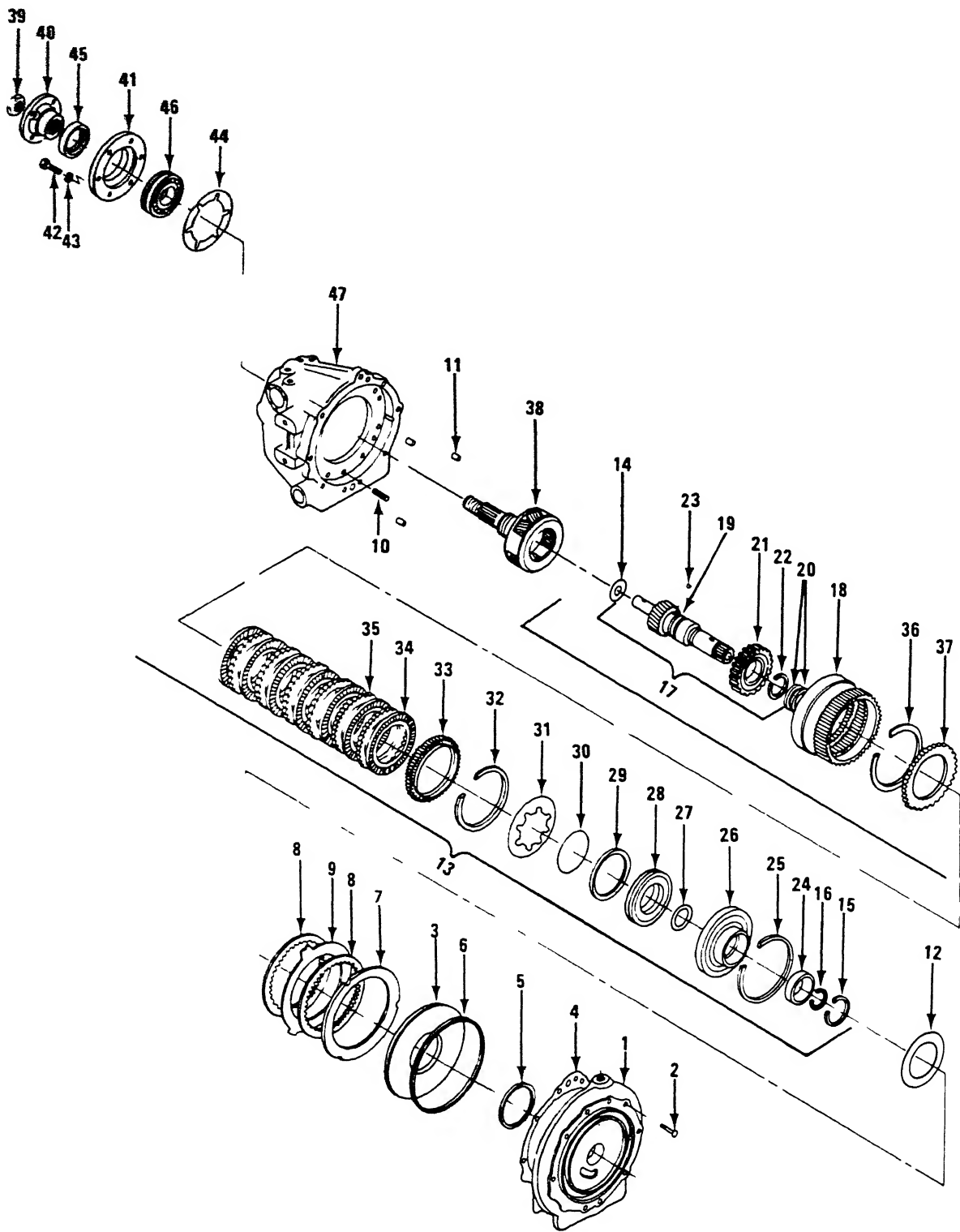
TRANSMISSION REPAIR INSTRUCTIONS (Continued)



TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
19	Gears, splines	b. Replace any bearing found to have chips, cracks, or discoloration.	
		a Visually inspect for Burrs or Nicks.	
		b Remove small burrs with fine stone	
20	Shafts	c Replace if gear or spline is nicked or burred	
		a Visually inspect for Scratches or Scouring	
		b Replace any shaft that is scratched or scoured	
21	Clutches	a Visually inspect metal clutch plates for Scouring	
		b Replace any scoured metal plates	

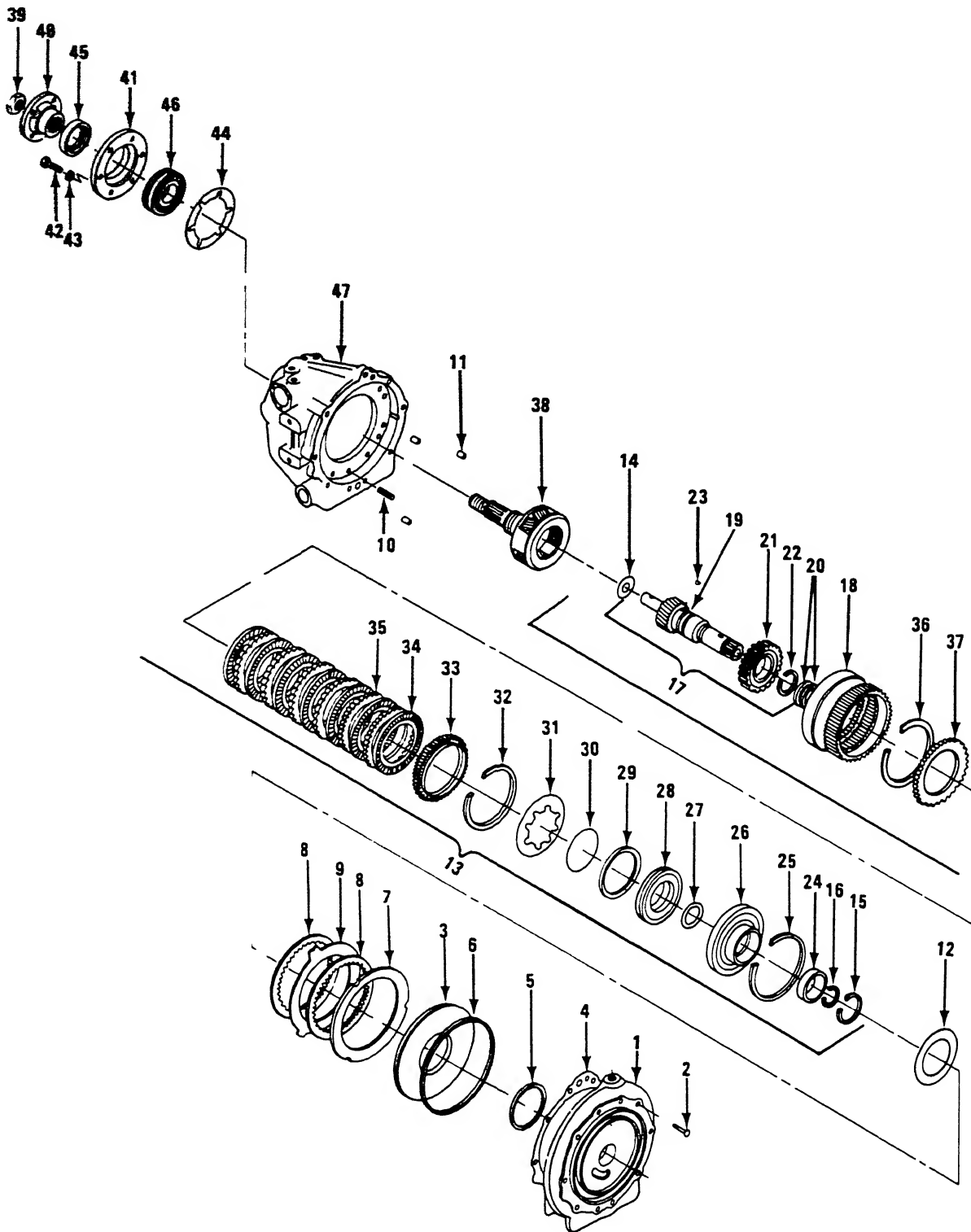
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		c. Visually inspect non-metallic clutches for Glazing or Tearing	
		d. Replace any glazed or torn non-metallic plates	
22	Rear coupling	a Visually inspect hub diameter for Scratches or Burrs	
		b Replace if defective	
23	Forward clutch piston	a Visually inspect inner diameter for Burrs or Scratches	
		b Remove burrs or scratches	Use crocus cloth

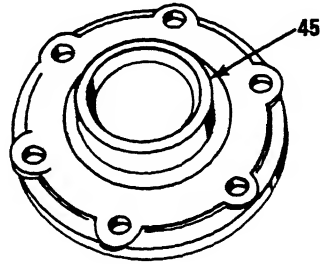
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS (Continued)

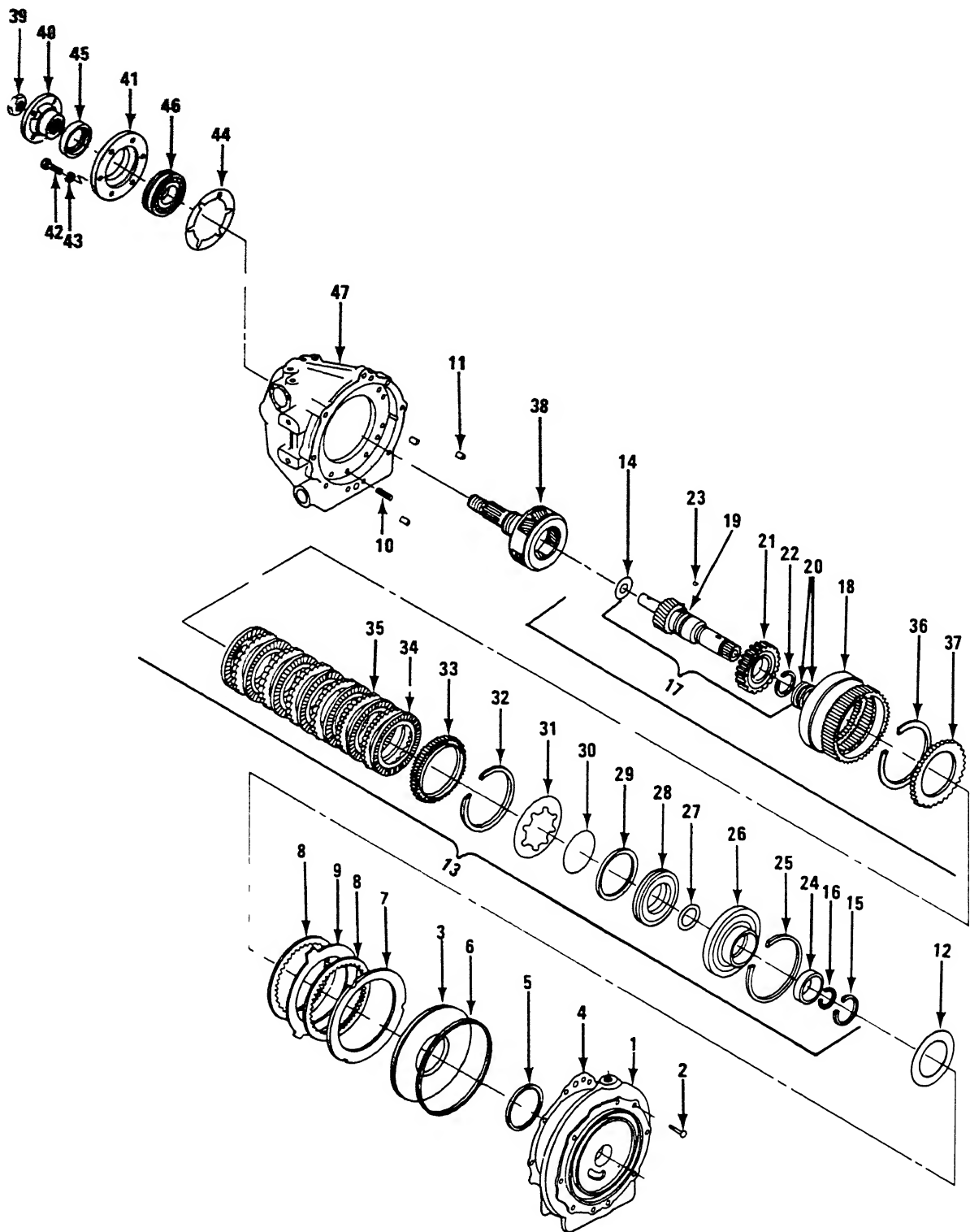
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

ASSEMBLY



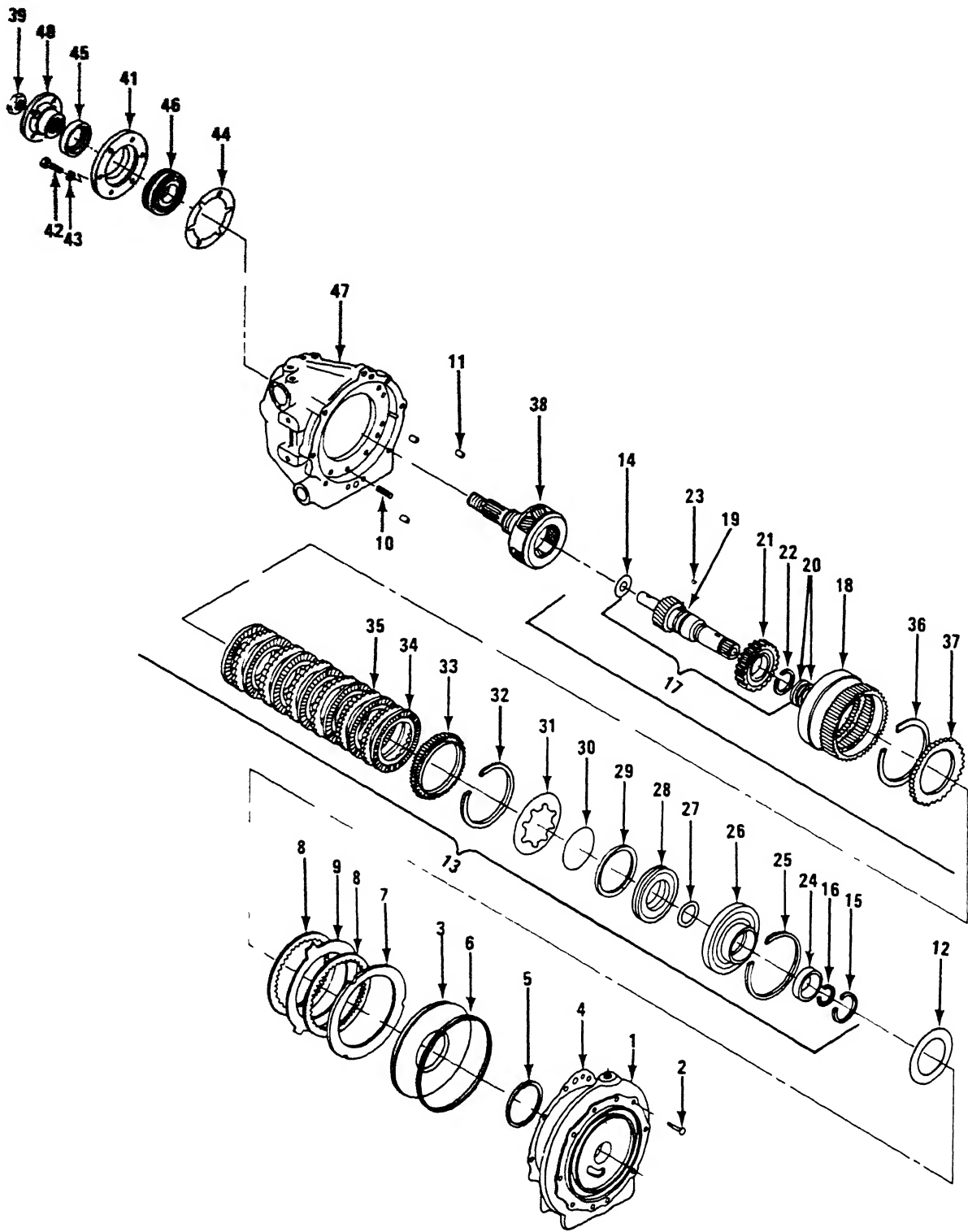
24	Bearing retainer (41)	Oil seal (45)	<p>a Place front face of re- tainer on arbor press table</p> <p>b Apply sealant to outside dia- meter of seal</p> <p>c Place seal squarely into bore of re- tainer with seal lip down</p> <p>d Press seal into retainer until rear face of seal is flush with retainer rear face</p>	Use arbor press and bearing assembly tool of correct size
----	--------------------------	---------------	--	--

TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS (Continued)				
LOCATION	ITEM	ACTION	REMARKS	
25 Arbor press table	a Pinion cage and output shaft assembly (38)	Place assembly with shaft pointing upward on 5 in diameter 2-7/8 in long assembly tool which is resting on arbor press table	Use bearing assembly tool	
	b Transmission case (47)	Place case over shaft and tool so case rests squarely on arbor press table		
26 Pinion cage and shaft assembly (38)	Annular bearing (46)	a Lubricate all parts with clean engine oil before assembly Move case as necessary to align shaft, bearing and case		
		b Place bearing with groove in outer diameter away from transmission case over shaft and squarely in bearing bore on case		
		c Press bearing down until seated against shaft or case shoulder	Use arbor press and bearing assembly tool which is locally fabricated (refer to Appendix C)	

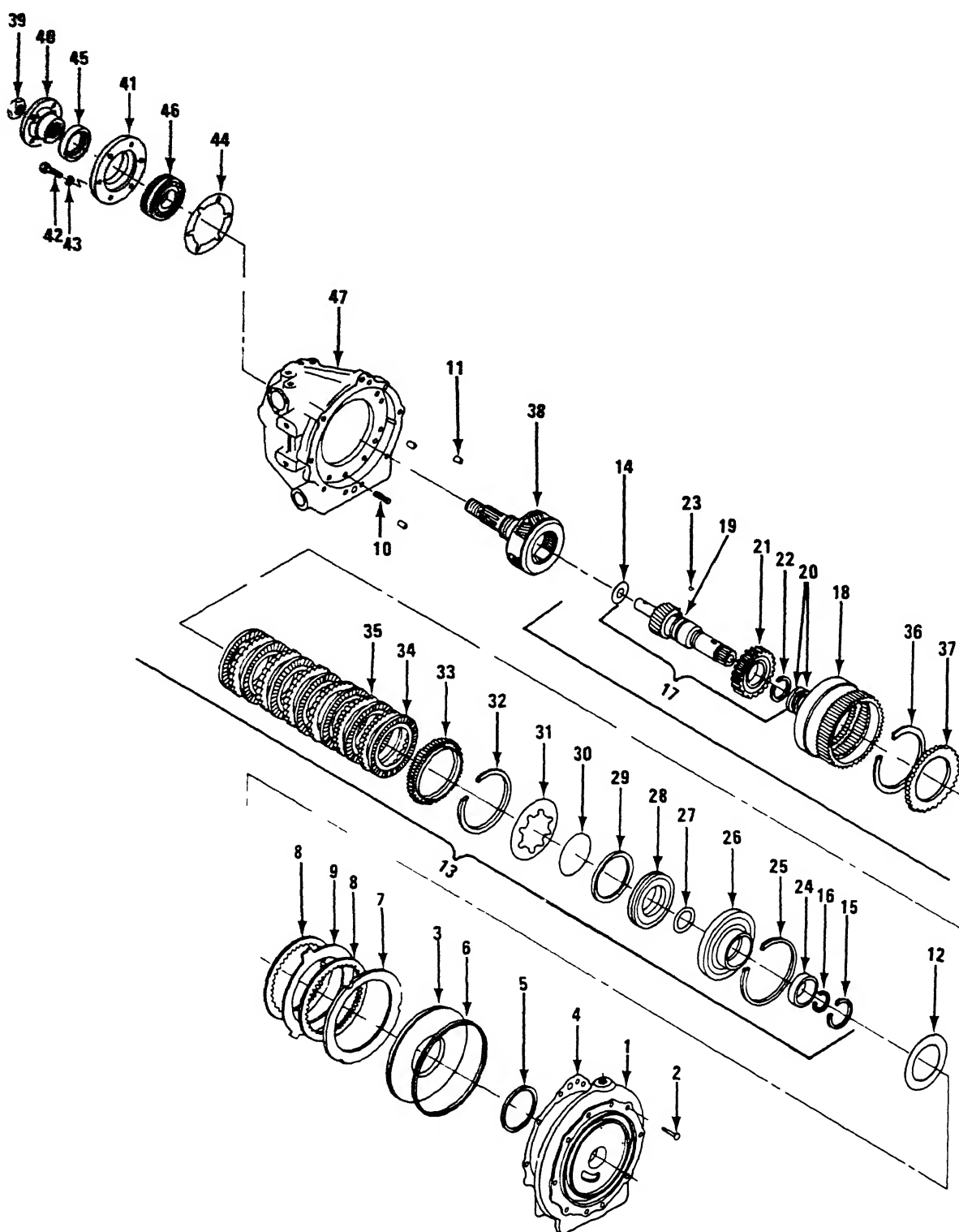
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



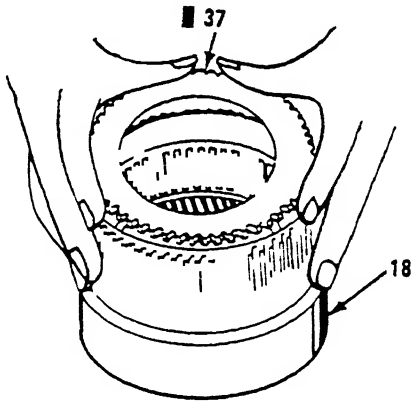
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
27. Transmission case (47)	a. Bearing retainer gasket (44)	Smear with petro-leum jelly and position on case.	Arbor press must be raised.
	b. Bearing retainer (41)	Position over bearing (46).	
28 Bearing retainer (41)	6 lockwashers (43) and 6 bolts (42)	Install and torque to 42 - 50 ft-lb	
29 Pinion cage and output shaft (38)	a Coupling (40)	a Lubricate all surfaces with clean engine oil	
		b Assemble splined portion of coupling onto splined portion of output shaft by hand as far as possible	
		c Gently press coupling onto shaft until contact with bearing inner race is made	Use arbor press
NOTE			
Case with pinion cage and output shaft assembly may now be removed from arbor press table. Coupling flange should be clamped in vise to secure it for next step.			

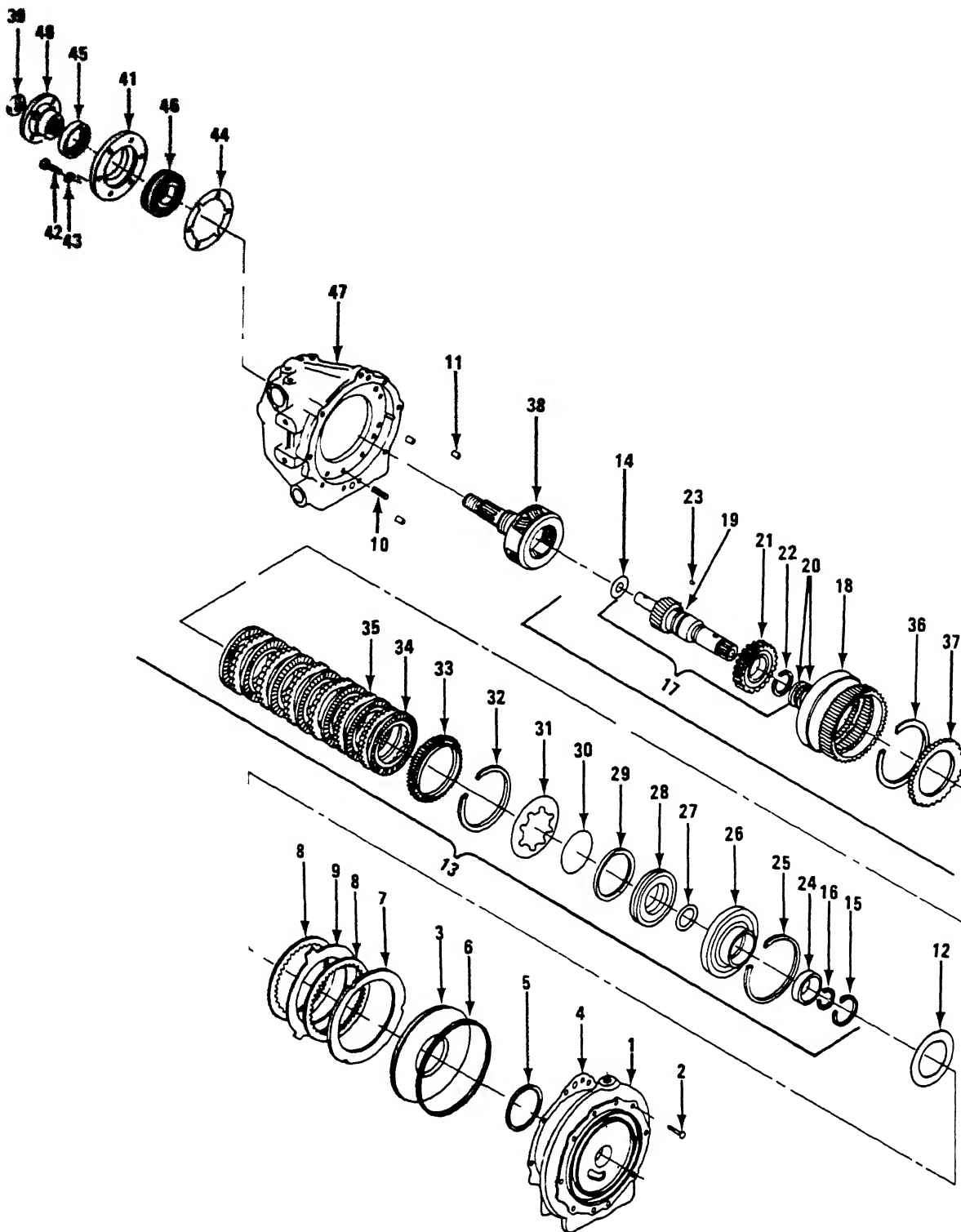
TRANSMISSION REPAIR INSTRUCTIONS (Continued)



TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	b Main shaft nut (39)	a Install and torque to 140 - 150 ft-lb b After tightening remove assembly from vise	There should be no detectable end play in coupling-output shaft combination
<p>NOTE</p> <p>Transmission case-pinion cage output shaft subassembly should be placed on work surface with face up and resting on coupling face to be ready for further assembly</p>			
			
30 Ring gear (18)	a Clutch pressure plate (rear) (37)	a Place ring gear on clean surface with external teeth up b Place clutch pressure plate, smoothly ground face up, into ring gear	The clutch pressure plate should seat firmly and squarely on shoulder at bottom of internal splines. This is above internal helical teeth.

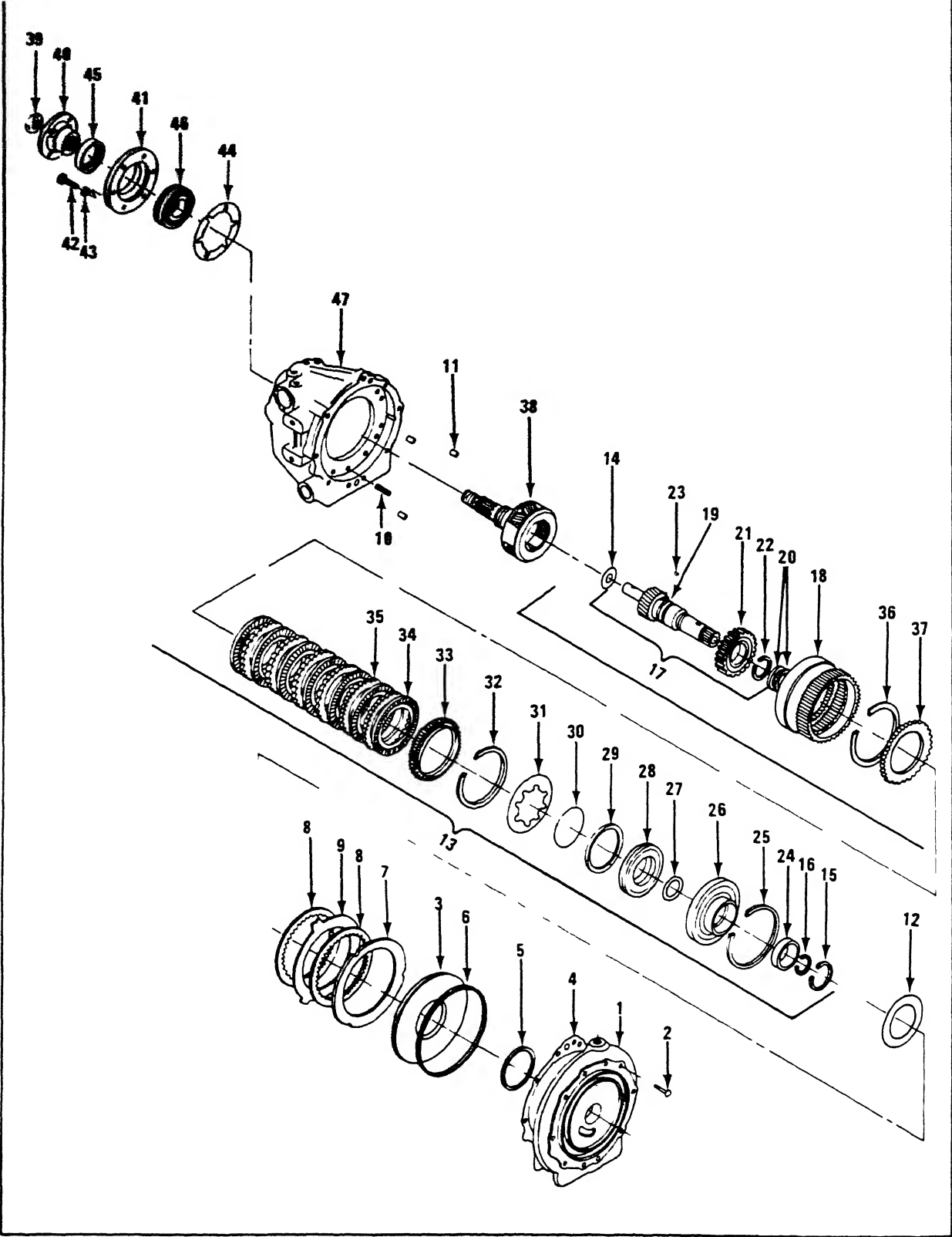
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

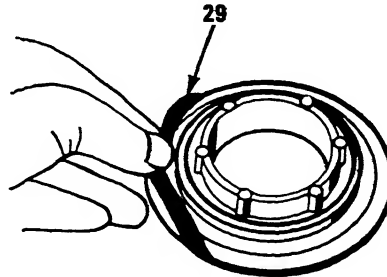
LOCATION	ITEM	ACTION	REMARKS
	b Clutch inner plates (34) and clutch outer plates (35)	a Lubricate all plates with clean engine oil b Starting with an inner plate alternately install inner plates - outer plates in sandwich fashion	Use 7 inner plates and 6 outer plates. Start and end with inner plate
	c Clutch pressure plate (front) (33)	Install with smooth face down in contact with clutch inner plate	
	d Clutch spring snap ring (32)	Install	This ring seats on internal splines, not into ring groove. Snap ring is .090 to .093 inches thick and has free diameter 5-19/32 in + 1/16 in. BE SURE YOU HAVE RIGHT RING
	e Clutch spring (31)	Install with concave side down and seat firmly on snap ring	Domed side is up

TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



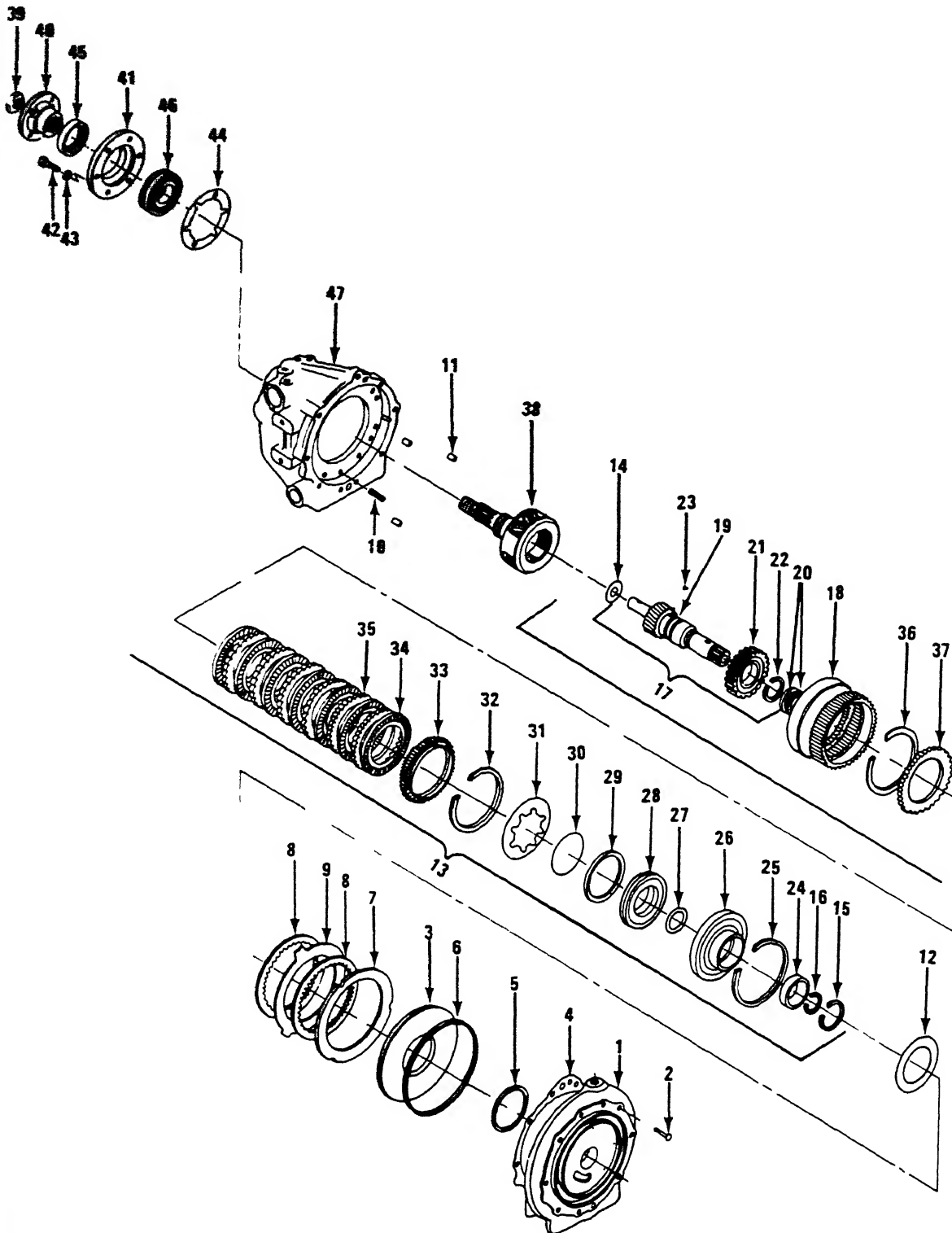
TRANSMISSION REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

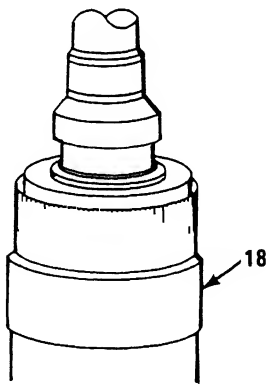
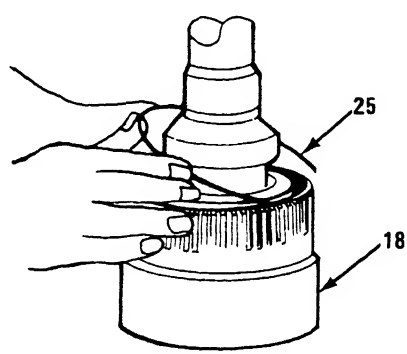


- | | | | |
|----|------------------------------|------------------------------------|---|
| 31 | Forward clutch piston (28) | a. Clutch spring bearing ring (30) | a Lubricate with clean engine oil. |
| | | | b Install in groove in piston face |
| | | b. Clutch sealing ring (29) | a Lubricate with clean engine oil |
| | | | b Install in piston outer diameter groove |
| 32 | Forward clutch cylinder (26) | a Sealing ring (27) | a Lubricate with clean engine oil |
| | | | b. Install in groove in forward clutch cylinder cavity. |

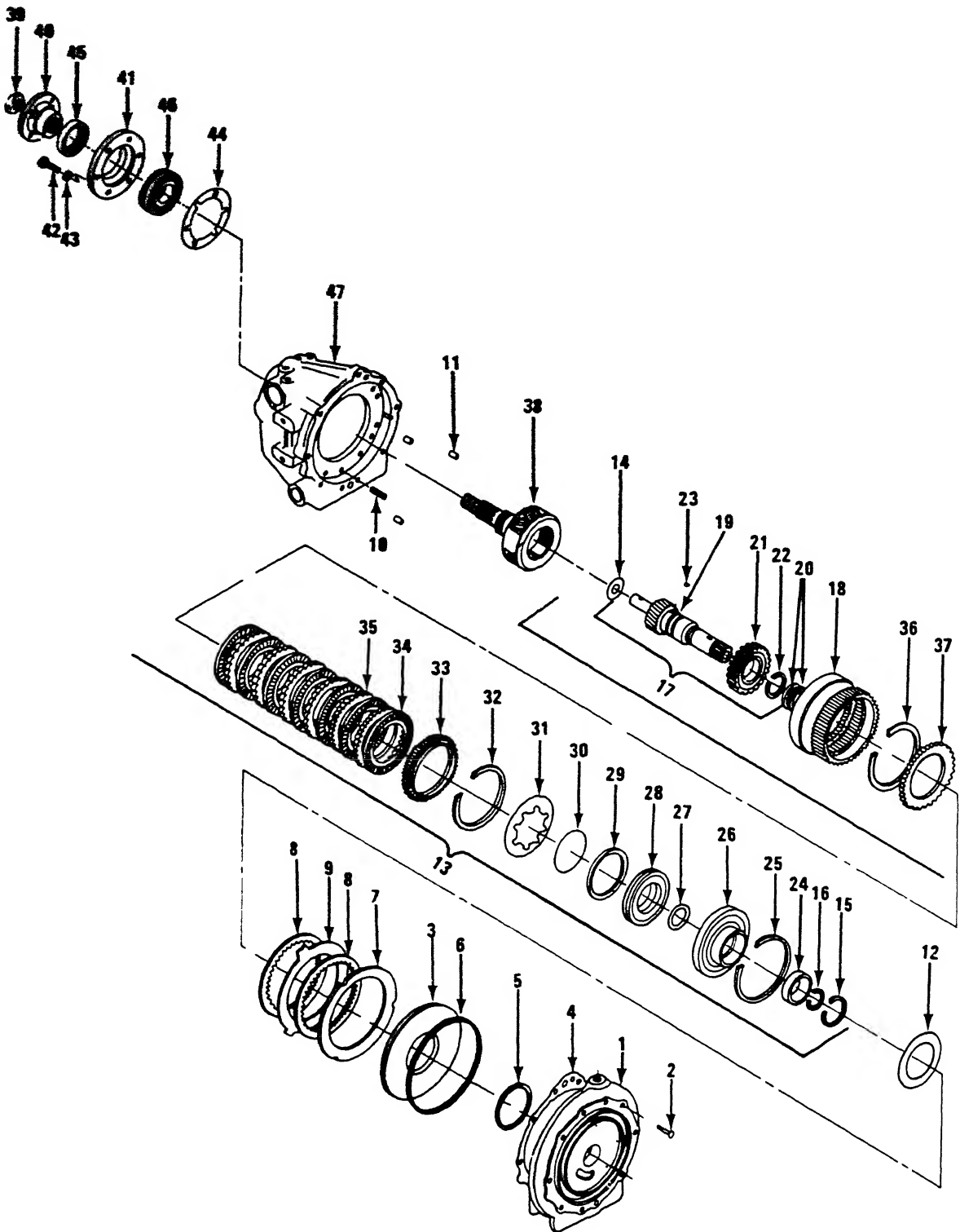
TRANSMISSION REPAIR INSTRUCTIONS (Continued)



TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	b Forward clutch piston (28)	<p>a. Aline piston squarely on forward clutch cylinder.</p> <p>b. Press piston into cylinder cavity making sure forward clutch cylinder sealing ring (27) remains in place</p>	<p>This is hand assembled and requires no hammering or pressing. Piston will bottom in forward clutch cylinder.</p>
<p>NOTE</p> <p>Take subassembly put together in step 30 and place on arbor press table</p>			
<div style="display: flex; justify-content: space-around; align-items: center;">   </div>			
33	Ring gear (18) subassembly	<p>a Clutch spring (31)</p> <p>b Forward clutch cylinder (26) as assembled in step 31</p>	<p>Center in ring gear</p> <p>a. Place in open top of ring gear</p> <p>The clutch spring bearing ring (30) in face of clutch cylinder piston (28) must face down and come in contact with</p>

TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS

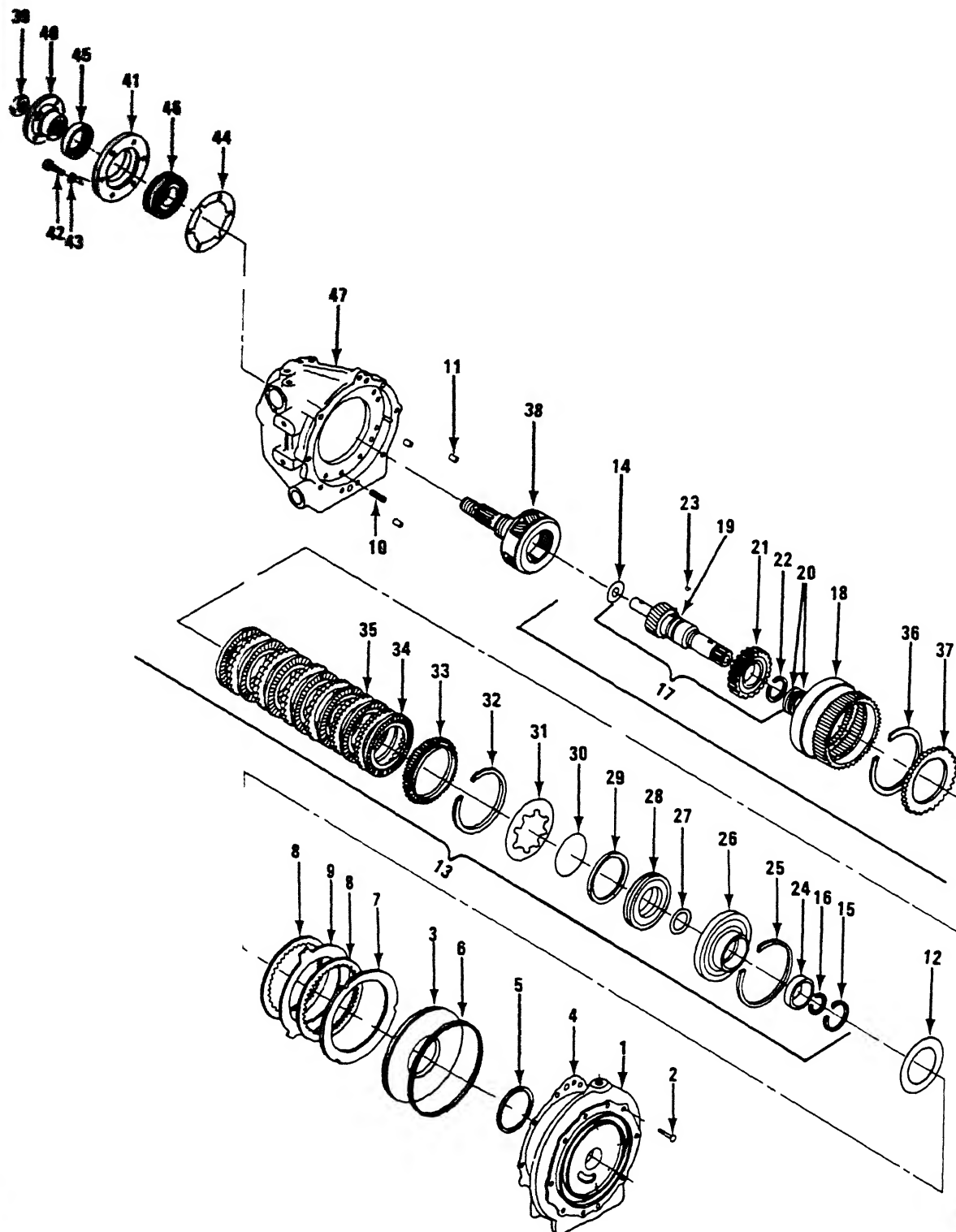
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		b Place assembly tool squarely on top of forward clutch cylinder and press down until the forward clutch cylinder is firmly seated on the clutch spring snap ring (32) and the gear snap ring groove is exposed	clutch spring (31) Assembly tool must fit over the collar on forward clutch cylinder and set squarely on cylinder body
	c Ring gear snap ring (25)	Install and tap to make sure ring seats in groove	Use non-metallic hammer Snap ring is .074 to .078 inches (1.89 to 1.99 mm) thick and has free diameter of 5-7/8 in + 1/16 in BE SURE YOU HAVE RIGHT SNAP RING

NOTE

The ring gear subassembly must be turned over at this point The external splines will now be on the bottom rather than the top

TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



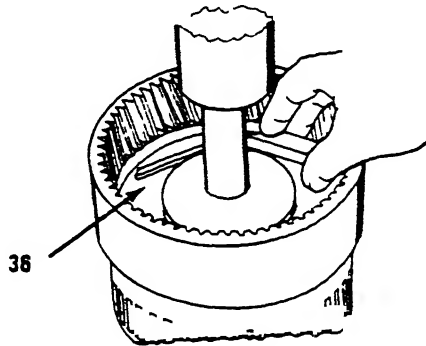
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION

ITEM

ACTION

REMARKS



d. Clutch pressure plate (rear) (37)

a Place assembly tool on plate and press down on plate

This will compress the clutch plates and pressure plates against clutch snap ring

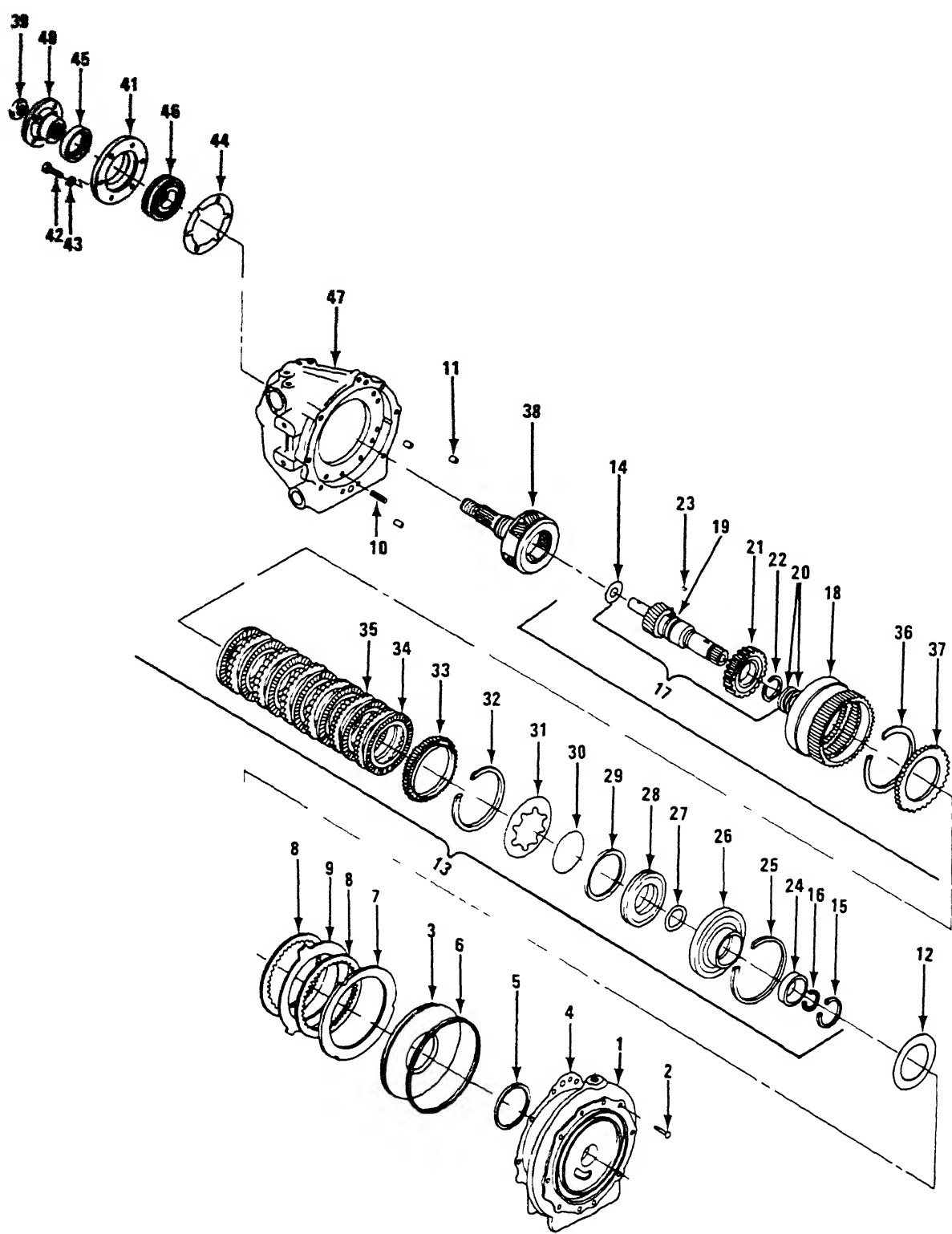
b Measure the gap between snap ring groove shoulder and pressure plate

Use feeler gage to measure gap

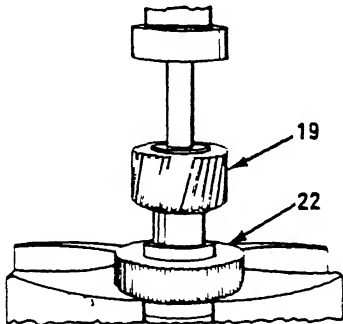
c Select one or more selective snap rings so as to obtain a clearance of .040 - .065 inches (102 .175 mm) between snap rings and the pressure plate

The selective snap ring has a free diameter of 5-11/16 inches. The rings are variable in thickness and color coded as follows:
Green - .050 - .054 inches (127 to 137 mm) thick, Orange - .074 - .078

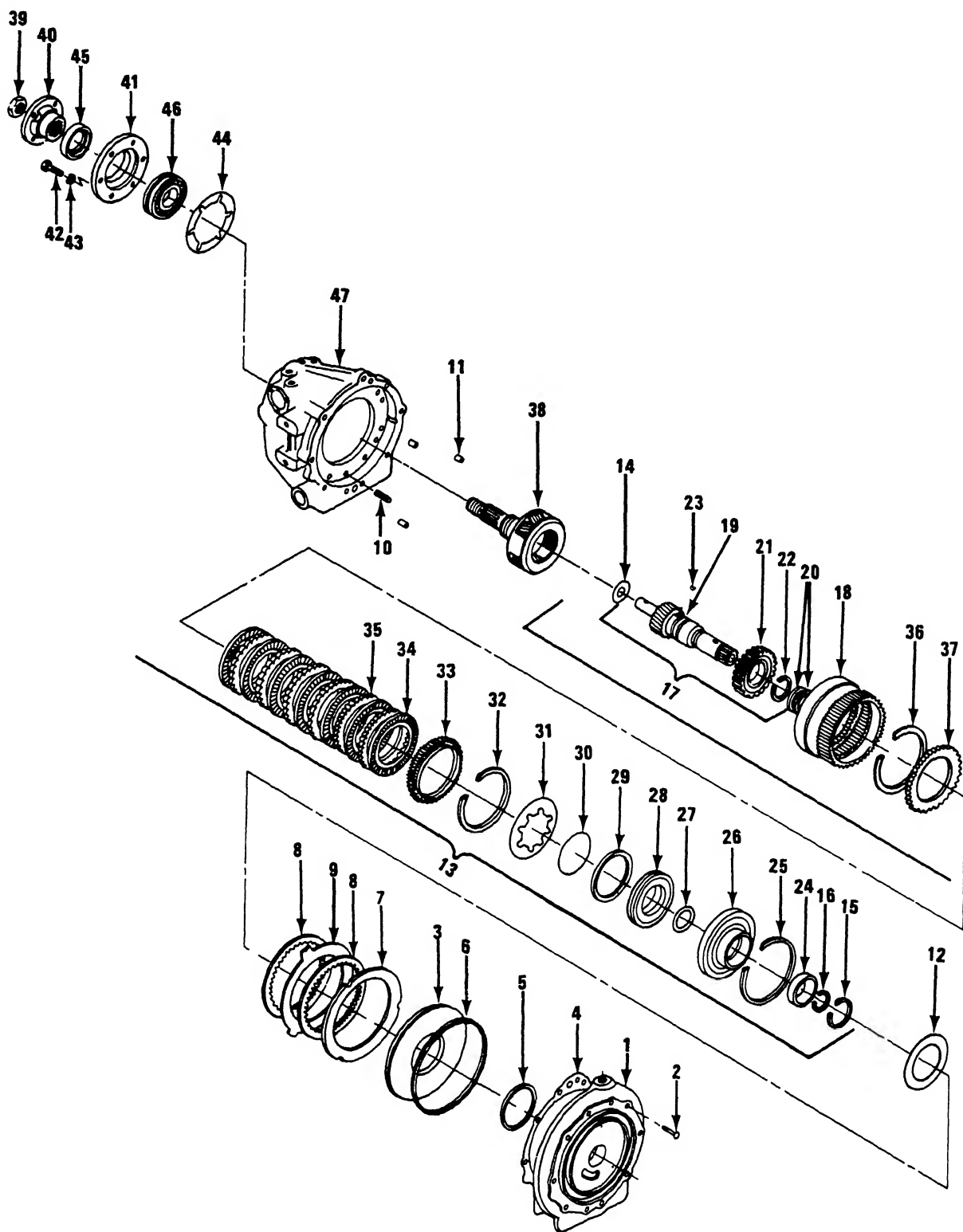
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
			inches (188 to .198 mm) thick, Blue - .084 - .088 inches (213 to 223 mm) thick, White - .096 - .100 inches (244 to 254 mm) thick
	e. Snap ring selective (36)	Install and tap to make sure ring seats in groove	Use non-metallic hammer
34 Arbor press table	Forward clutch hub (22)	Place on suitable support	Support must have opening allowing shaft to be pressed through hub
35 Drive gear (19)	Woodruff key (23)	Put into keyway on drive gear	
			
36 Forward clutch hub (22)	Drive gear (19)	a Lubricate gear with clean engine oil	Use arbor press to press drive gear into forward clutch hub

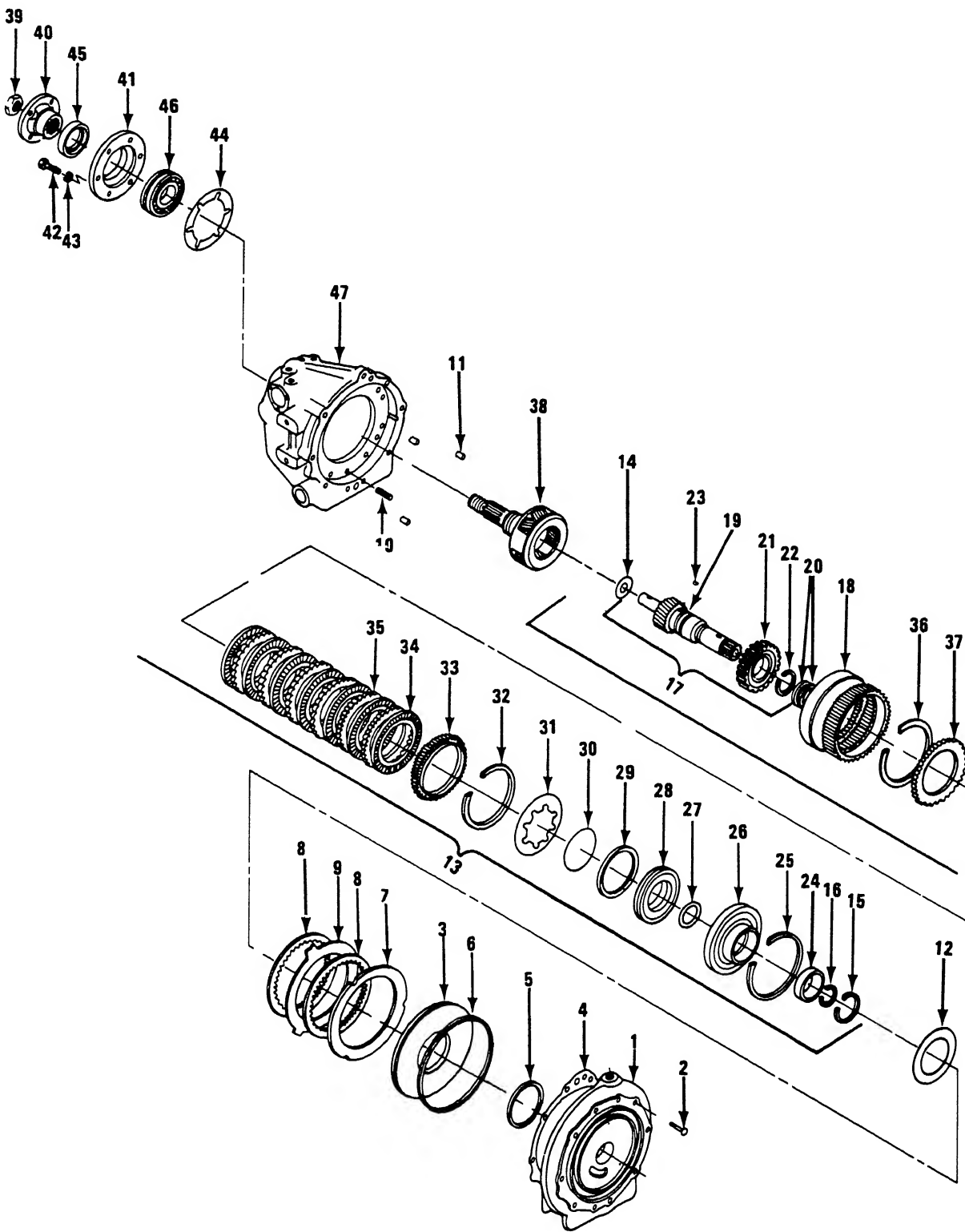
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
		<p>b. Install gear and key squarely into hub being careful to align the key and keyway in hub.</p> <p>c. Press drive gear into forward clutch hub until gear bottoms on hub and groove for snap ring is fully uncovered</p>	
<p>NOTE</p> <p>Remove items from press before next step</p>			
37 Drive gear shaft (19)	a Snap ring (21)	Install in groove	
	b 2 sealing rings (20)	<p>a Install in groove</p> <p>b After installation hold ends of shaft and turn rings to insure freedom of movement</p>	

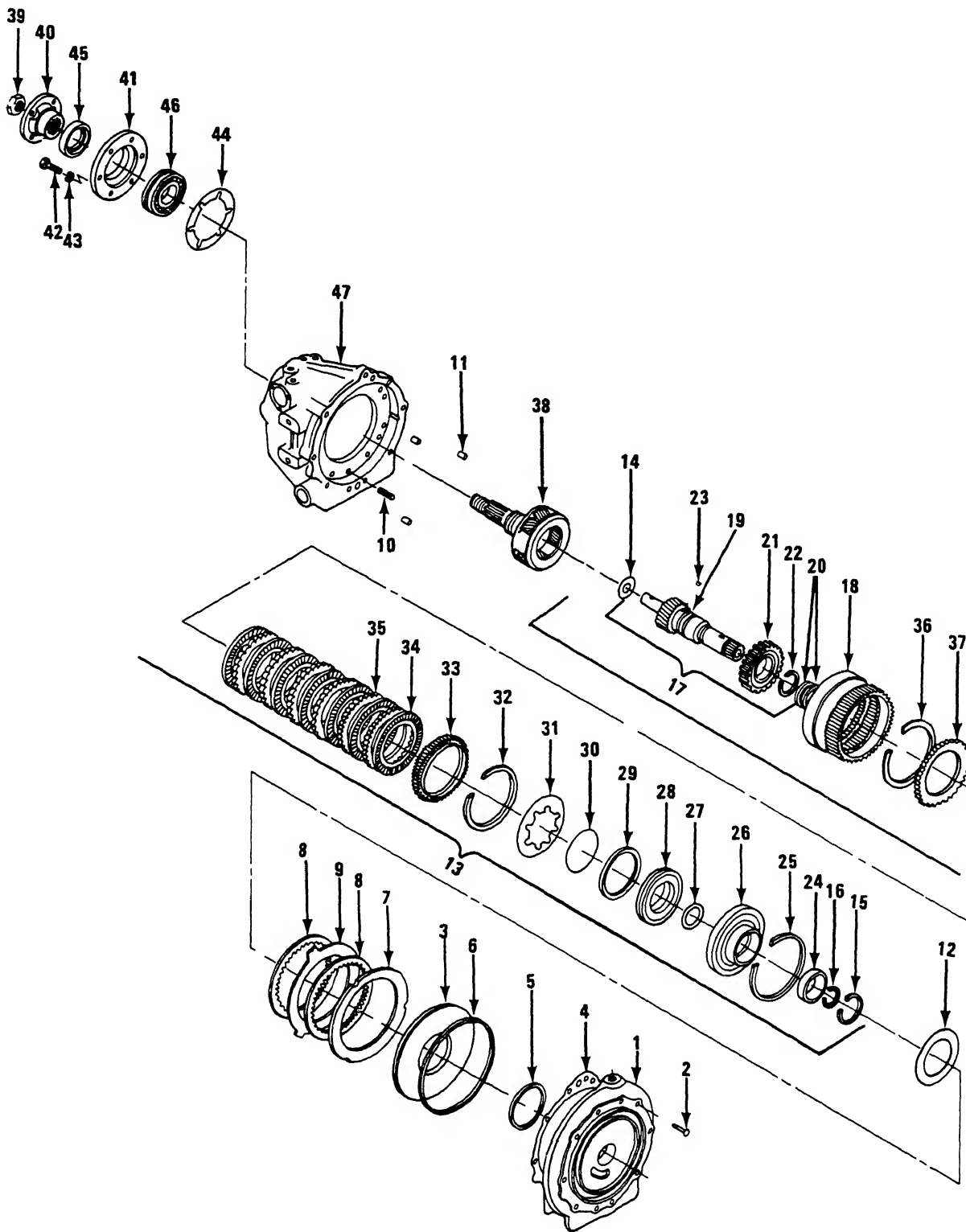
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



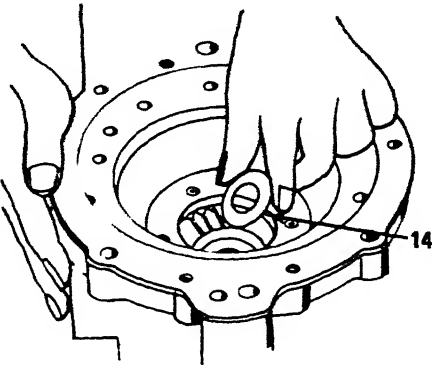
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		c. Rotate ring gear to aline teeth of plates with teeth on clutch hub. DO NOT FORCE.	When everything is in correct position the rear of ring gear should be against assembly tool or flush with rear thrust face of drive gear. DO NOT MOVE SUBASSEMBLY FROM ASSEMBLY TOOL OR MOVE GEAR FORWARD
NOTE			
Subassembly on assembly tool must be placed on arbor press table before next step			
	d Bearing (24)	a Place over protruding drive gear shaft (19) and aline with bore at front of forward clutch cylinder (26)	
		b Press bearing down until bearing is fully seated and snap ring grooves in front of bearing are exposed.	
	e External snap ring (16)	Install on drive gear shaft.	
	f Internal snap ring (15)	Install in clutch cylinder.	

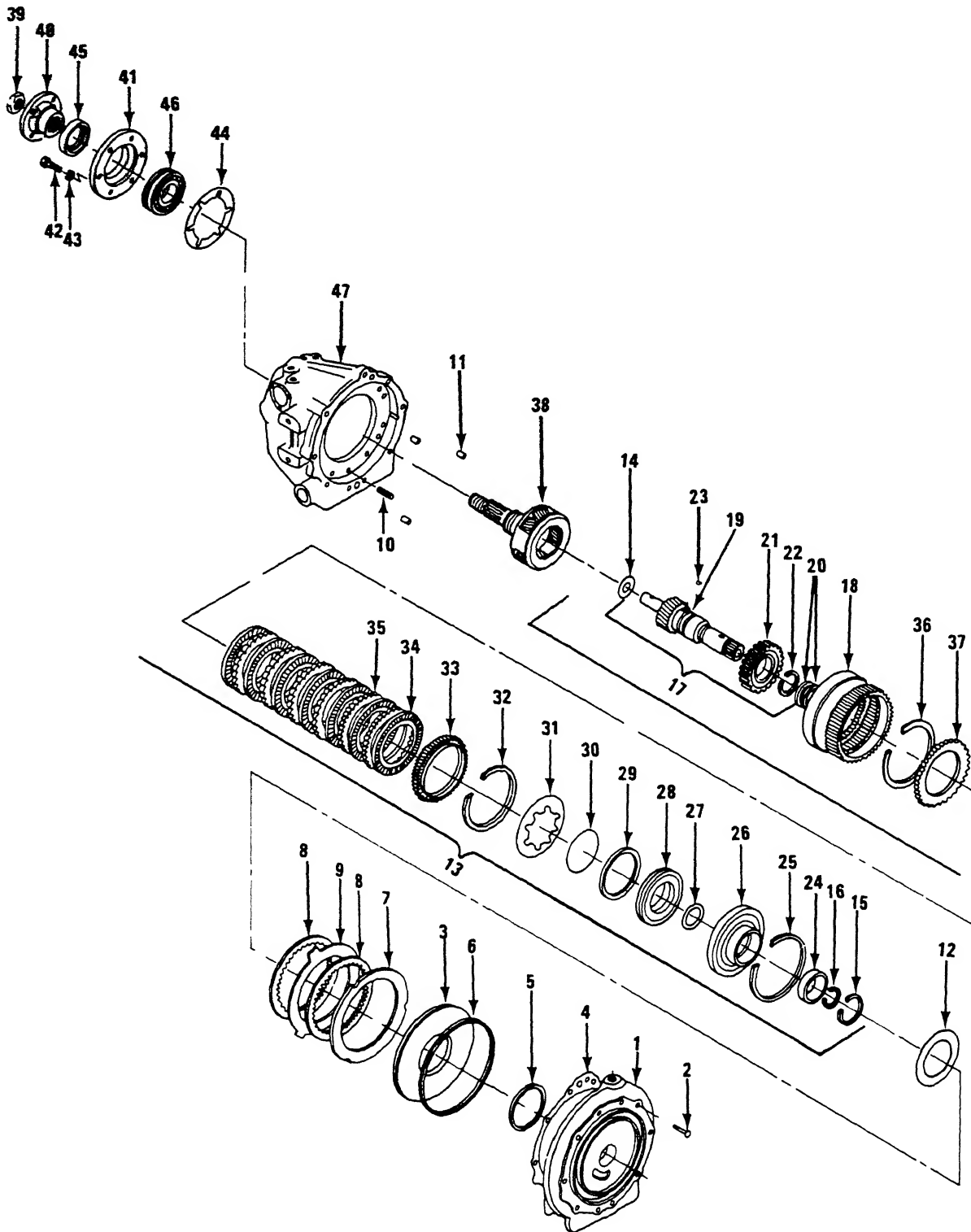
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS
 (Continued)

LOCATION	ITEM	ACTION	REMARKS
<p style="text-align: center;">NOTE</p> <p>Transmission case must be positioned so that it is resting on rear face of rear coupling for next steps.</p> 			
38 Pinion cage and output shaft (38)	a Thrust washer (14)	a Coat with petroleum jelly	Output shaft has hollow center to receive drive gear protrusion when ring gear subassembly is fitted into transmission
		b Assemble into pinion cage, centering washer carefully over bore in output shaft	

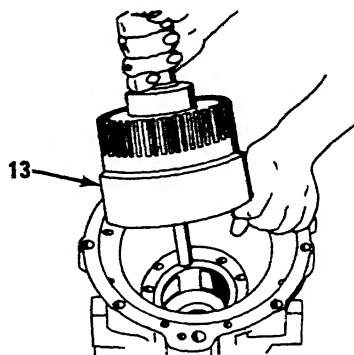
TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------



b Ring gear subassembly (13)

a Lubricate rear end of drive gear shaft (19)

b Check centered position of thrust washer

c Install ring gear subassembly into pinion cage

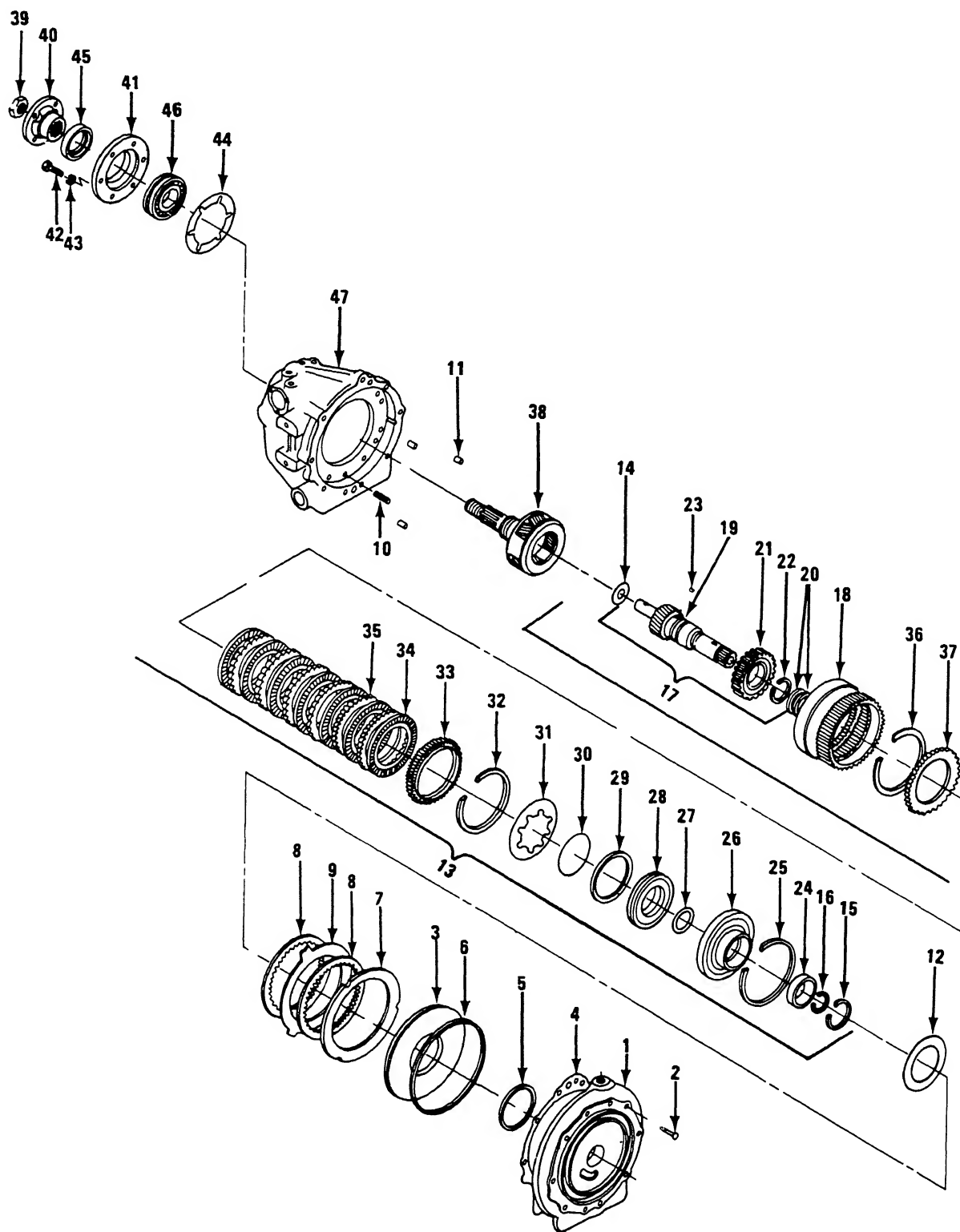
External splines on ring gear are up Exercise care and proper centering to prevent damage when rear diameter of drive gear enters pinion cage

c Ring gear subassembly (13)

a. Lubricate with engine oil

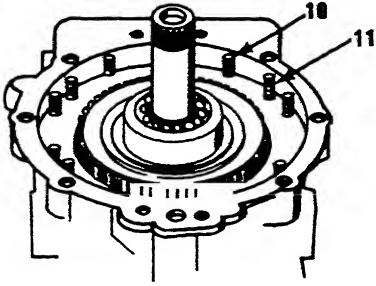
b Place in case (47)

TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

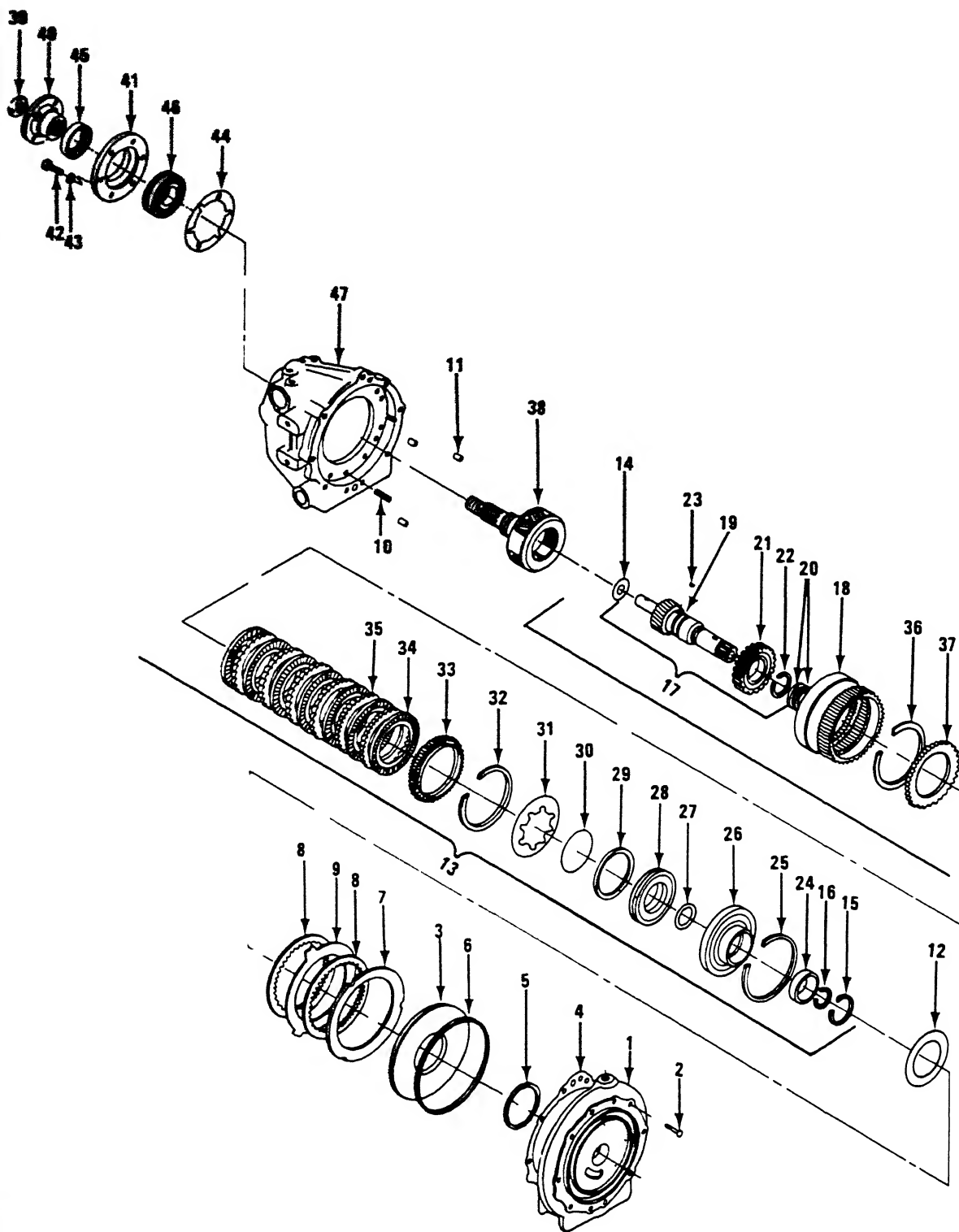


TRANSMISSION REPAIR INSTRUCTIONS

(Continued)

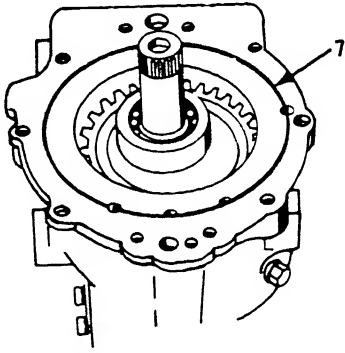
LOCATION	ITEM	ACTION	REMARKS
			
39 Transmission case (47)	a 12 pressure plate springs (10)	Place springs in holes in reverse clutch cavity in case (47)	Holes free of dirt and springs firmly seated
	b Dowel pins (11)	a Coat with petroleum jelly b Install in three grooves at outside diameter of reverse clutch cavity in case (47)	Pin goes into groove as far as possible and seats firmly
	c Reverse clutch plate (8)	Install over exposed spline teeth of ring gear (18)	

TRANSMISSION REPAIR INSTRUCTIONS (Continued)

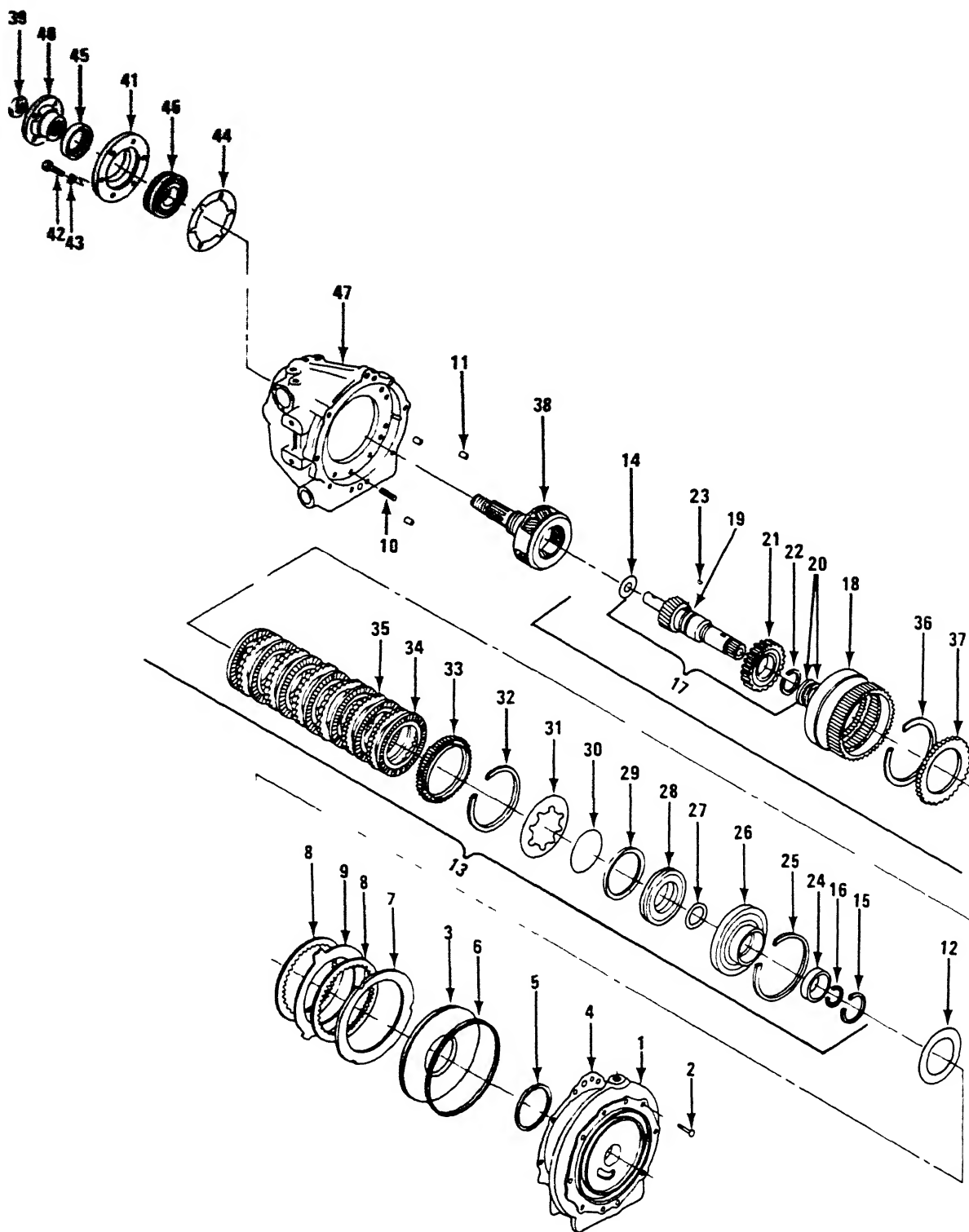


TRANSMISSION REPAIR INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
	d. Outer clutch plate (9)	Install with odd shaped lug to lower left as one would face the open transmission.	Lower left is approximately 8 o'clock when facing open end of transmission.
	e. Reverse clutch plate (8)	Install second plate on top of outer clutch plate and over exposed splined teeth of ring gear	
			
	f Reverse clutch pressure plate (7)	<p>a Install with 12 holes down and over springs (10)</p> <p>b Aline cast slot in plate outer diameter with large oil hole in top of transmission case face.</p>	<p>There is large oil hole in bottom of transmission face case. Do not use this hole as alignment hole. Pressure plate should position with face approximately flush</p>

TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

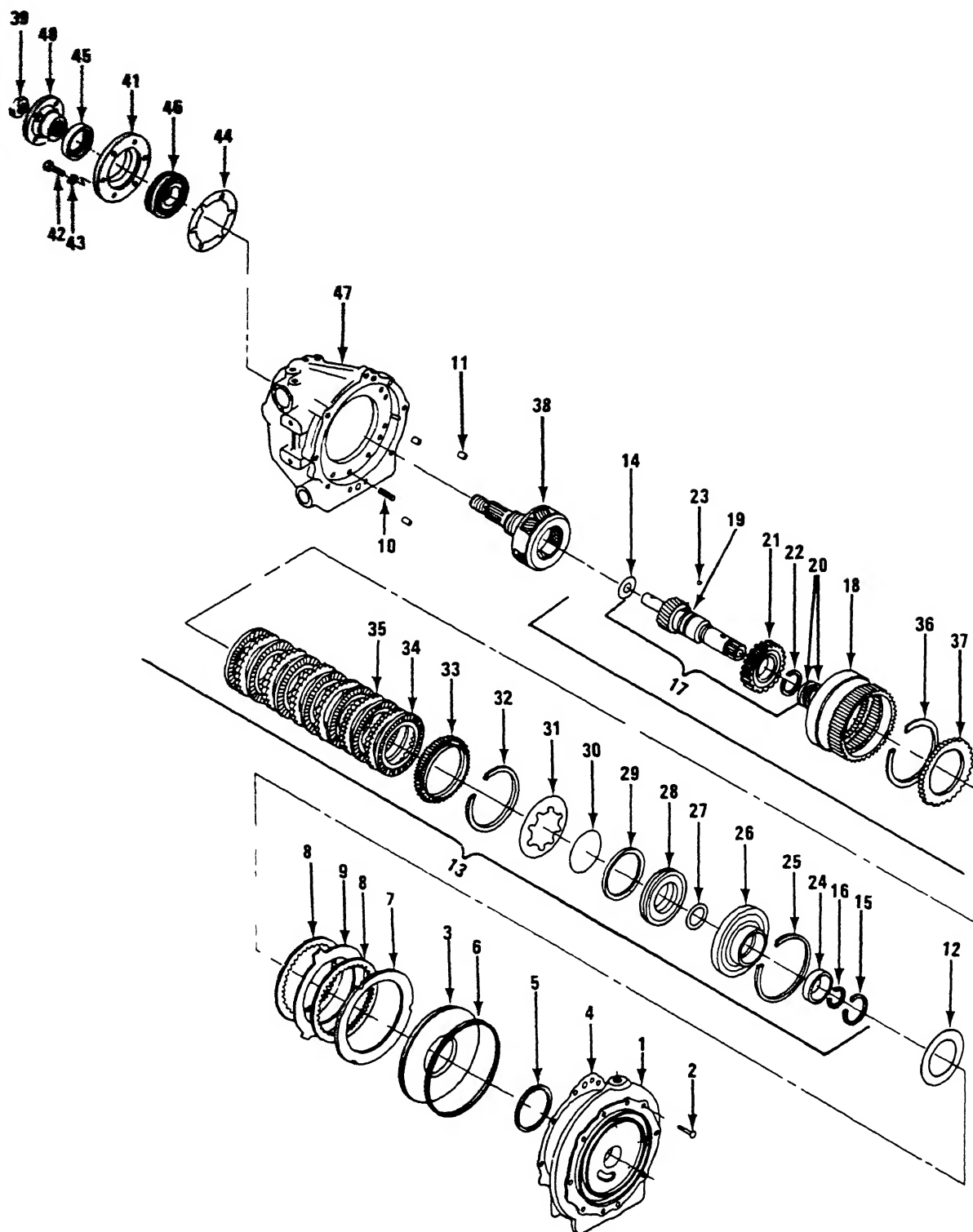


TRANSMISSION REPAIR INSTRUCTIONS

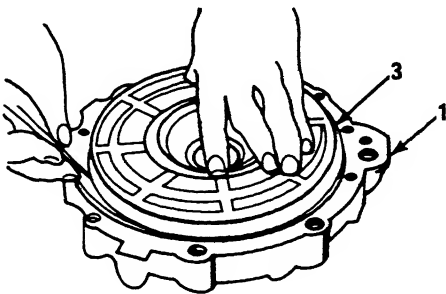
(Continued)

LOCATION	ITEM	ACTION	REMARKS
			with case front face. If it does not check dowel pins and springs for misalignment.
	g. Thrust washer (12)	a. Coat with petroleum jelly	
		b. Install onto forward clutch cylinder (26)	
NOTE			
Before next step place forward-reverse adapter (1) with open face up on flat surface			
40 Forward and reverse adapter (1)	Sealing ring (5)	a Lubricate with clean engine oil	
		b Install in groove in adapter	
41 Reverse clutch piston (3)	Sealing ring (6)	a Lubricate with clean engine oil	
		b. Install in groove on piston outer diameter.	

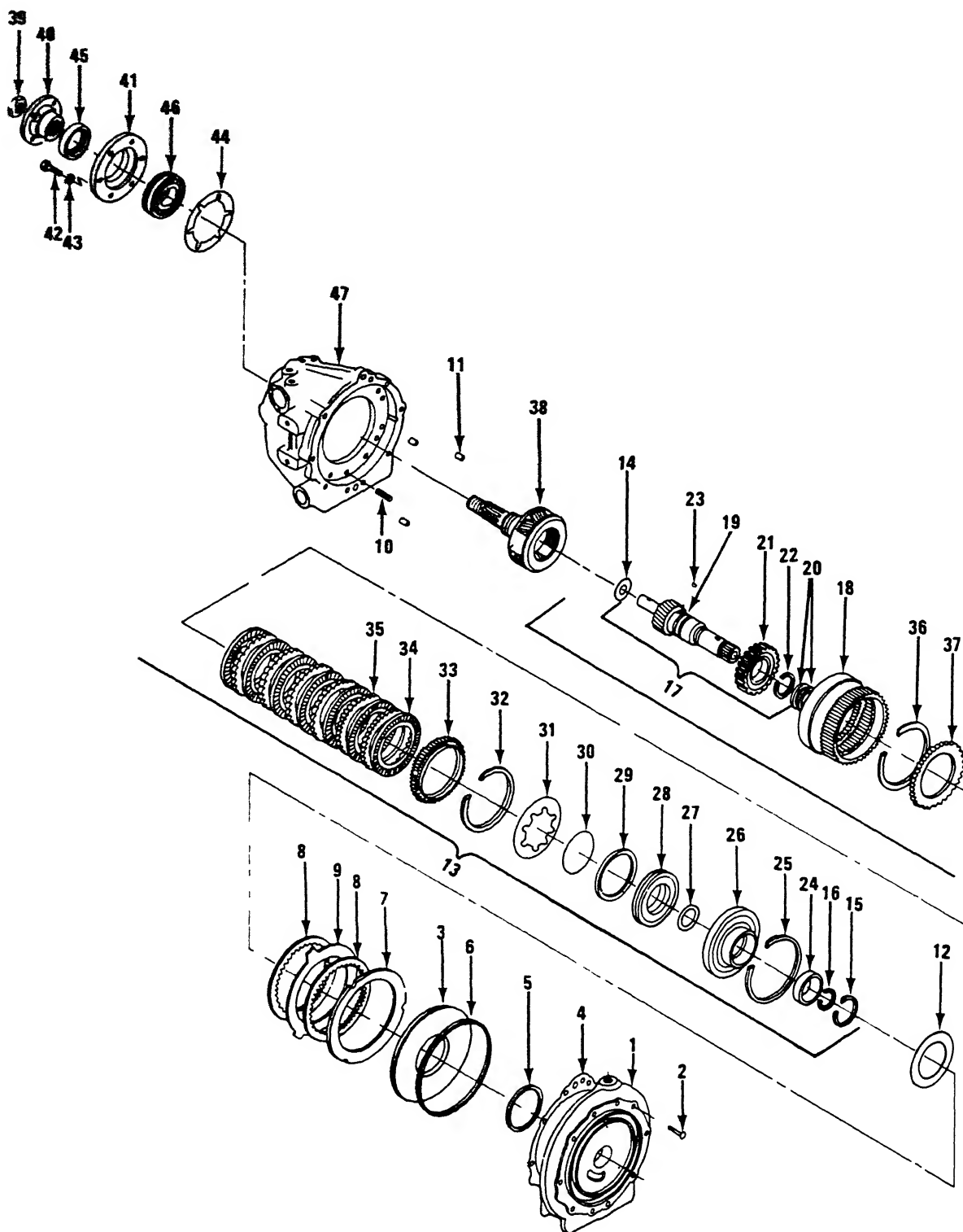
TRANSMISSION REPAIR INSTRUCTIONS (Continued)



TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
			
42. Forward and reverse adapter (1)	Reverse clutch piston (3)	<p>a Lubricate all surfaces with clean engine oil prior to starting procedure Exposed face of clutch piston should be flush with adapter when assembly completed</p> <p>b Place piston, ribbed side up, on adapter</p> <p>c Press down on piston while pulling a clean, smooth screwdriver blade around the exposed portion of sealing ring</p>	<p>This compresses ring to allow piston to slip into adapter.</p>

TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

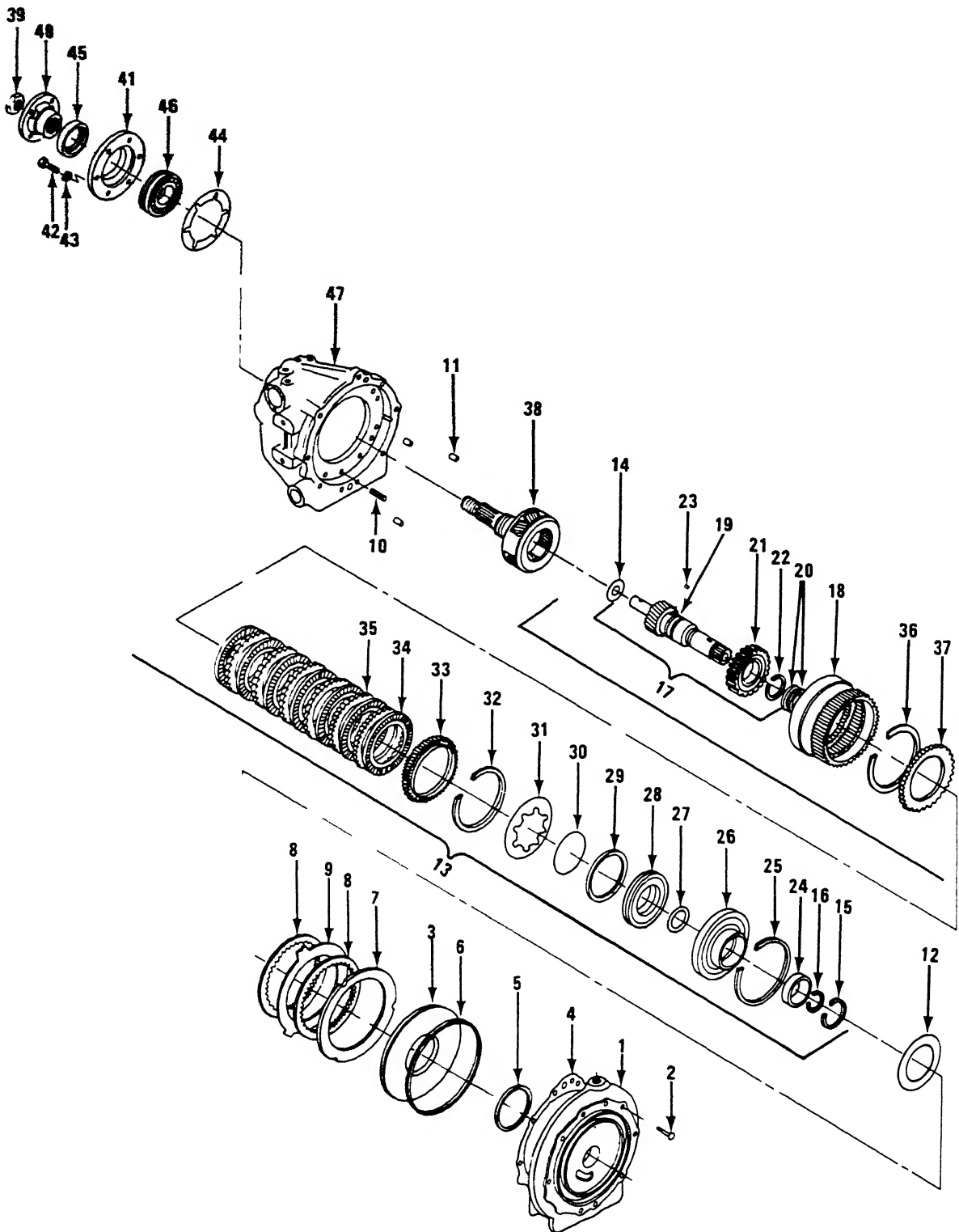


TRANSMISSION REPAIR INSTRUCTIONS

(Continued)

LOCATION	ITEM	ACTION	REMARKS
		d. Assembly can be completed using hand pressure until piston bottoms in adapter (1).	
43 Transmission case (47)	a Adapter gasket (4)	a. Coat with petroleum jelly.	Aline all holes.
		b Position on exposed front face of case.	
	b Forward and reverse adapter (1)	a. Fit squarely over input shaft and lower as far it will go	The plug in adapter is at top of adapter This alines with top of transmission Shoulder on rear of adapter should enter mating bore in reverse clutch cavity
		b Aline oil holes in adapter with those in case	
NOTE			
Before proceeding to next step check gap between adapter and case at several points to insure that adapter is squarely in place			
44 Adapter (1)	4 cap screws (2)	a Install and tighten finger tight Alternately tighten each cap screw 1/2 turn at a time to draw adapter into place	Tighten the bolts in an X pattern to insure proper draw down

TRANSMISSION REPAIR INSTRUCTIONS
(Continued)



TRANSMISSION REPAIR INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. When seated, torque cap screws to 27 - 37 ft-lb.	
		NOTE	
	FOLLOW-ON MAINTENANCE PROCEDURE procedure (reference page 3-9) procedure (reference page 2-327)	Perform oil pump installation Perform control valve installation	

HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION

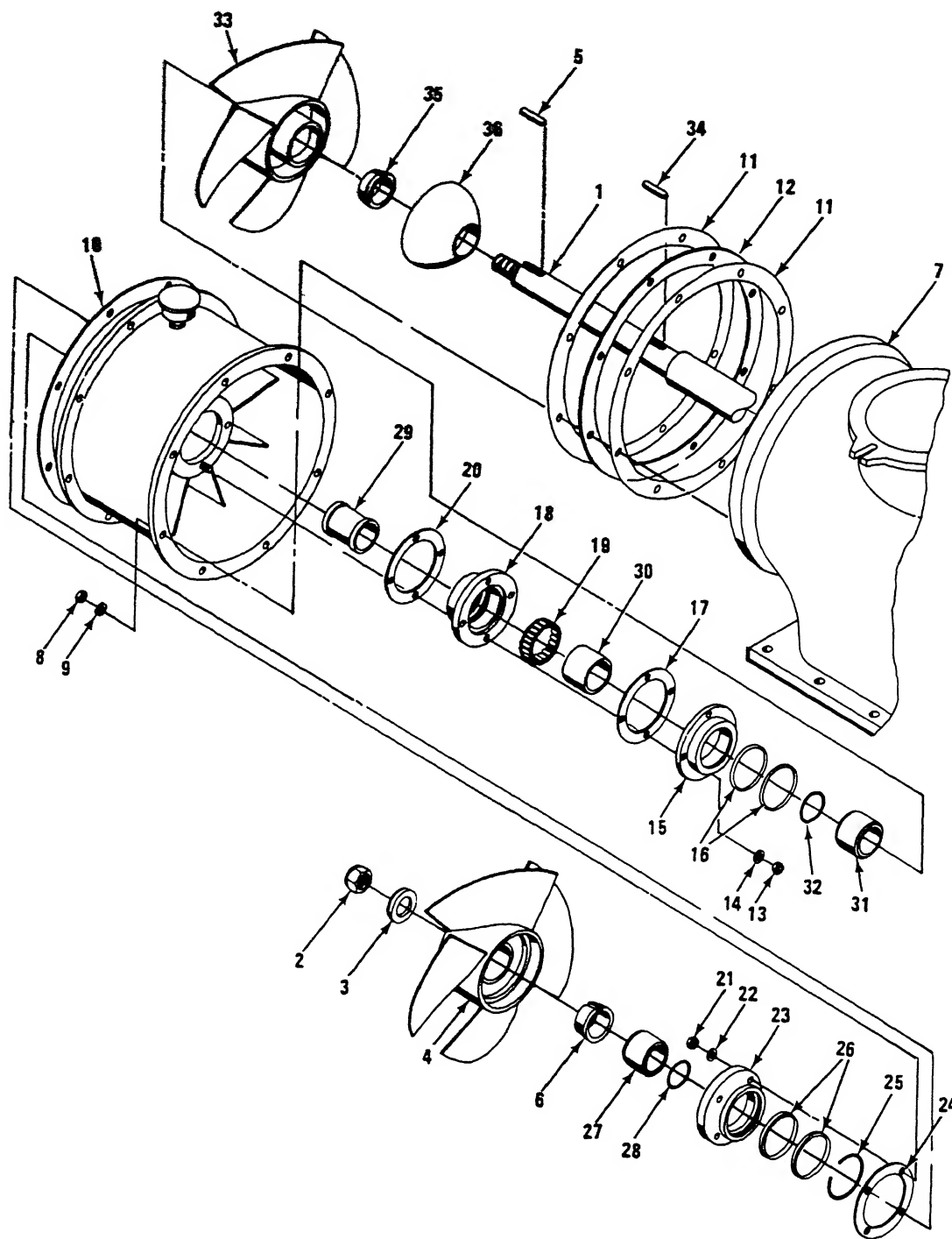
This task covers

- a. Disassembly
- b. Inspection
- c. Assembly

INITIAL SETUP

Tools	Equipment Condition	Condition Description
30 mm socket	Page 2-353	Hydrojet assembly removed from boat.
Torque wrench (0 - 175 ft-lb)		
8 mm hex key wrench (Allen)		
12 mm open/box wrench		
13 mm open end wrench		
Snap ring pliers		
Strap wrench		
Long nose pliers		
Ratchet		
Feeler gage		
Materials/Parts		
Gaskets		
Shaft seals		
Front reaction case gaskets		
Grease		
O-rings		
Personnel Required	Two	

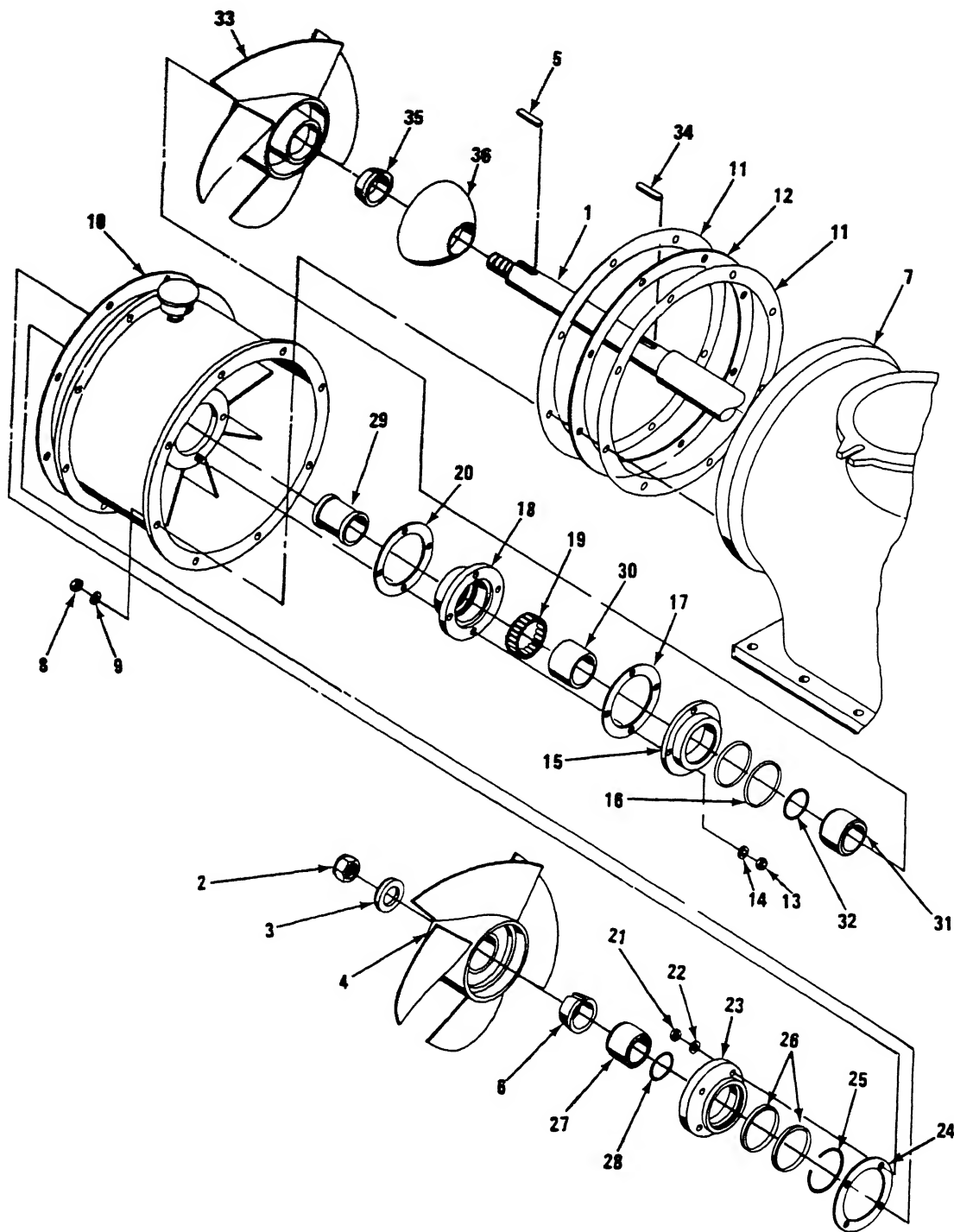
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION (Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>DISASSEMBLY</u>			
1. Hydrojet assembly shaft (1)	a. Rear shaft nut (2), washer (3)	a. Hold drive flange located at other end of shaft and unscrew.	Use strap wrench to hold flange.
		b. Remove.	Use 30 mm socket and ratchet
	b. Rear impeller (4)	Slide off shaft	
	c. Key (5)	Remove	
	d. Rear impeller cone (6)	Slide off shaft	
2. Front reaction case (10)	Wear measurement	Measure clearance between tip of impeller blade and case. Should be not greater than .0591 inch (1.5 mm). Replace impeller and case if clearance too great.	Use feeler gage
3. Intake case (7)	a. 8 nuts (8) and 8 washers (9) securing front reaction case (10) to intake case (7)	Remove	Use 12 mm wrench

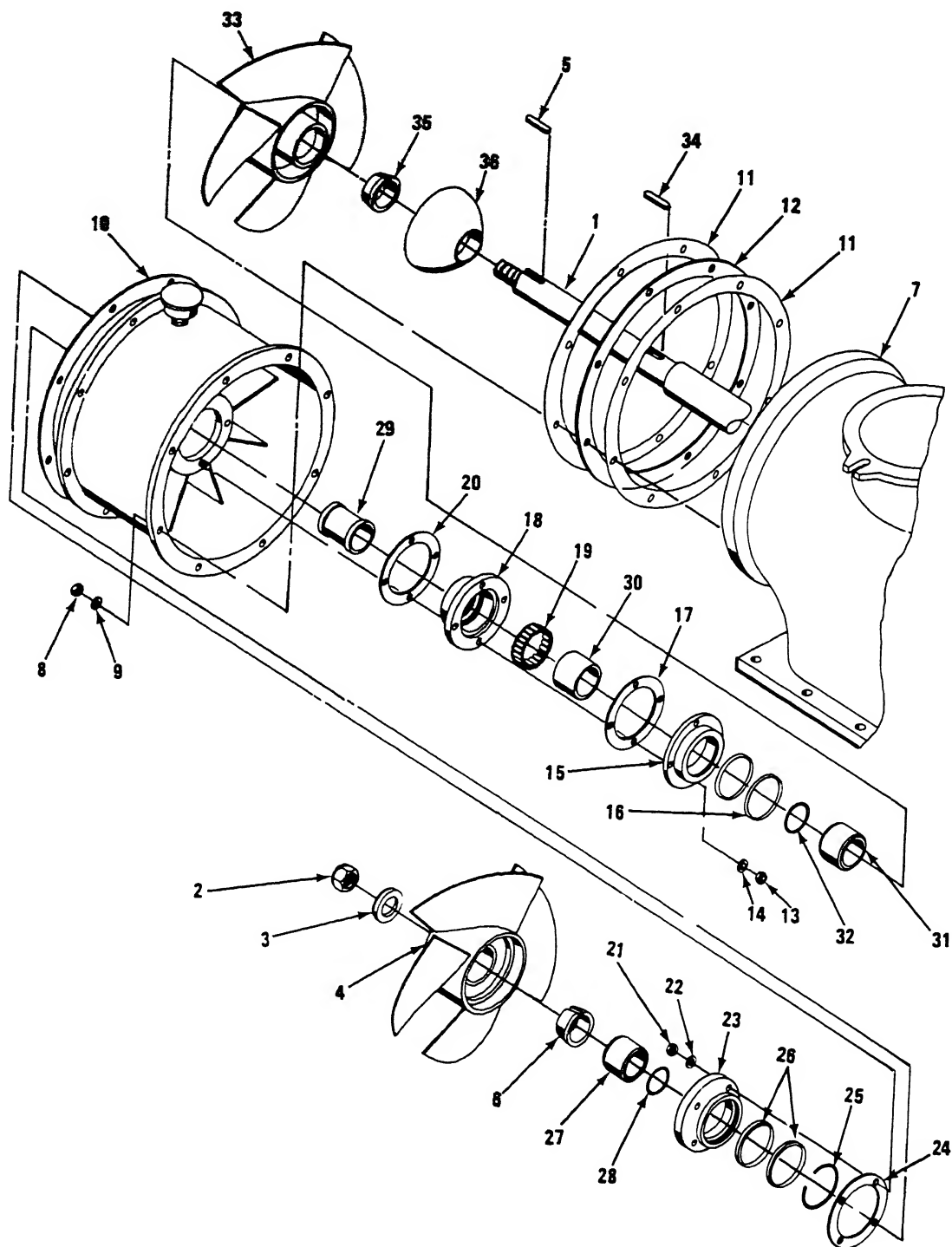
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION (Continued)

LOCATION	ITEM	ACTION	REMARKS
	b. Front reaction case (10)	a. Remove, while holding all spacers, and seal sleeves in place on shaft while doing so. b. Lay side for further disassembly.	
	c 2 front reaction case gaskets (11) and front reaction insulating ring (12)	a. Remove. b. Discard gaskets	
4 Front reaction case (10)	a 4 seal and bearing housing retaining nuts (13) and 4 lockwashers (14) retaining seal and bearing housing	Remove	Use 13 mm wrench
	b Seal housing (15)	Remove	
	c 2 seals (16)	Remove from seal housing	Use seal puller
	d Seal housing gasket (17)	Remove.	Discard

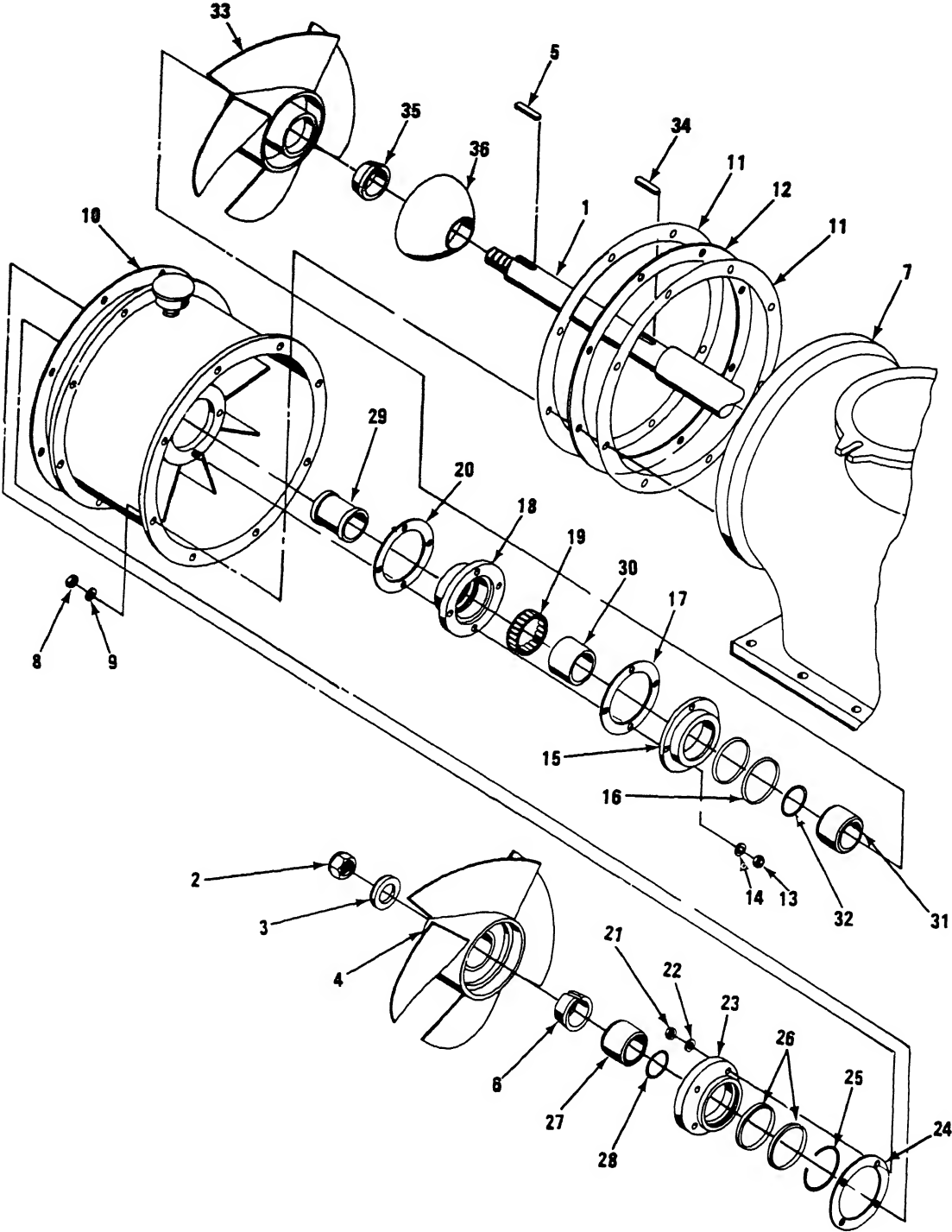
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION (Continued)

LOCATION	ITEM	ACTION	REMARKS
	e. Bearing housing (18)	Remove.	With bearing.
	f. Bearing housing gasket (20)	Remove and discard.	
5. Bearing housing (18)	Bearing (19)	a Press out of small end of housing. b. Lay aside for inspection.	Use press.
6 Front reaction case (10)	a 4 nuts (21) and 4 washers (22) retaining seal housing	Remove	Use 13 mm wrench
	b Seal housing (23)	Remove	
	c Seal housing gasket (24)	Remove and discard	
7 Seal housing (23)	a Snap ring (25)	Remove	Use long nose pliers
	b 2 seals (26)	Remove	Use seal puller Note direction of old installation for reference in new seal installation
8. Hydrojet assembly shaft (1)	Seal sleeve (27)	Slide off shaft.	

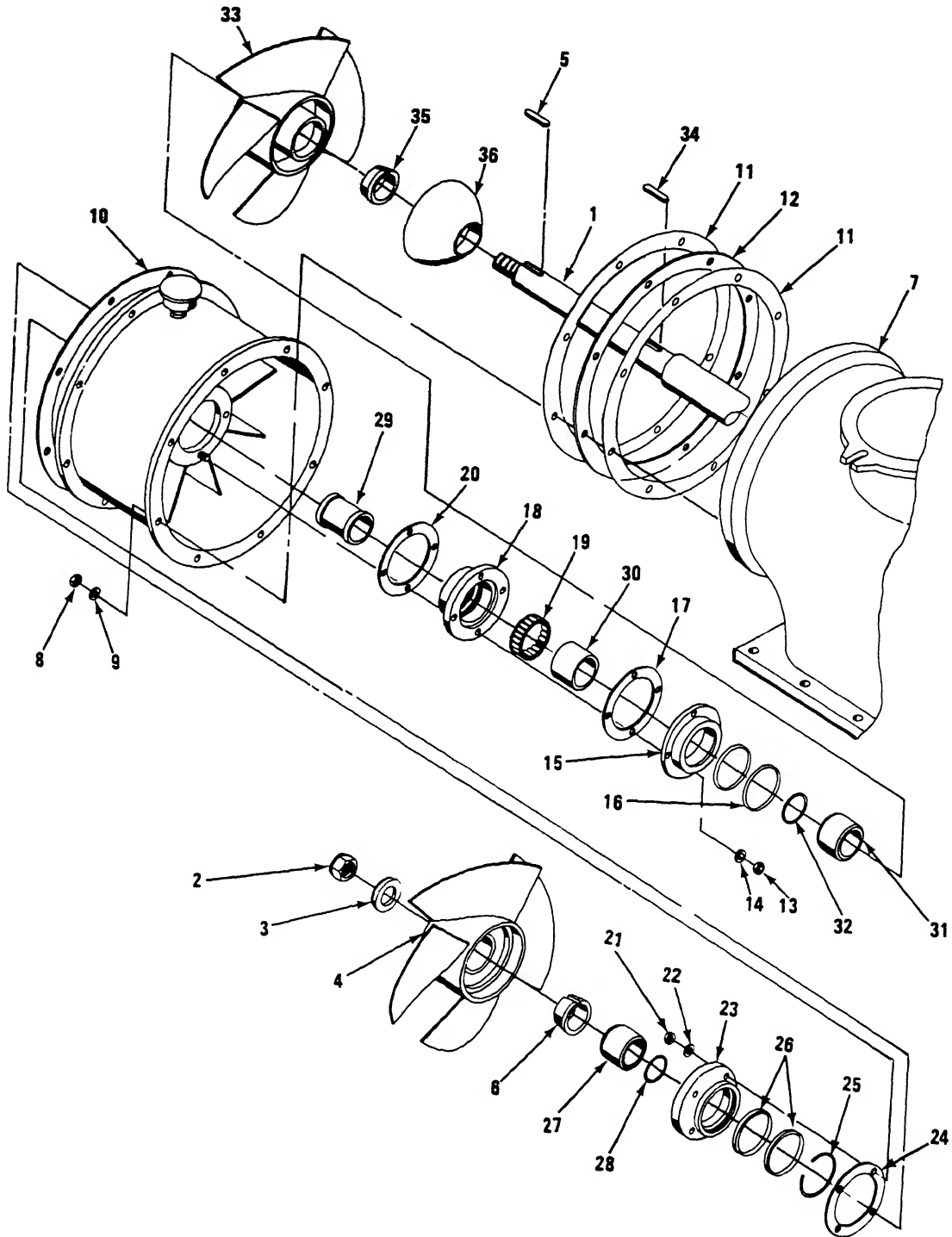
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION
(Continued)

LOCATION	ITEM	ACTION	REMARKS
9. Seal sleeve (26)	O-ring (28)	Remove and discard	
10. Hydrojet assembly shaft (1)	a. Spacer (29)	Slide off shaft.	
	b. Bearing inner race (30)	Slide off shaft.	
	c Seal sleeve (31)	Slide off shaft.	
11 Seal sleeve (31)	O-ring (32)	Remove and discard	
12 Hydrojet assembly shaft (1)	a Front impeller (33)	Slide off shaft	
	b Key (34)	Pull out	
	c Impeller cone (35)	Slide off shaft	
	d Fairing (36)	Slide off shaft	
<u>INSPECTION</u>			
13	Impeller (33)	a Inspect for cracks	
		b Replace if cracked.	

HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION
(Continued)



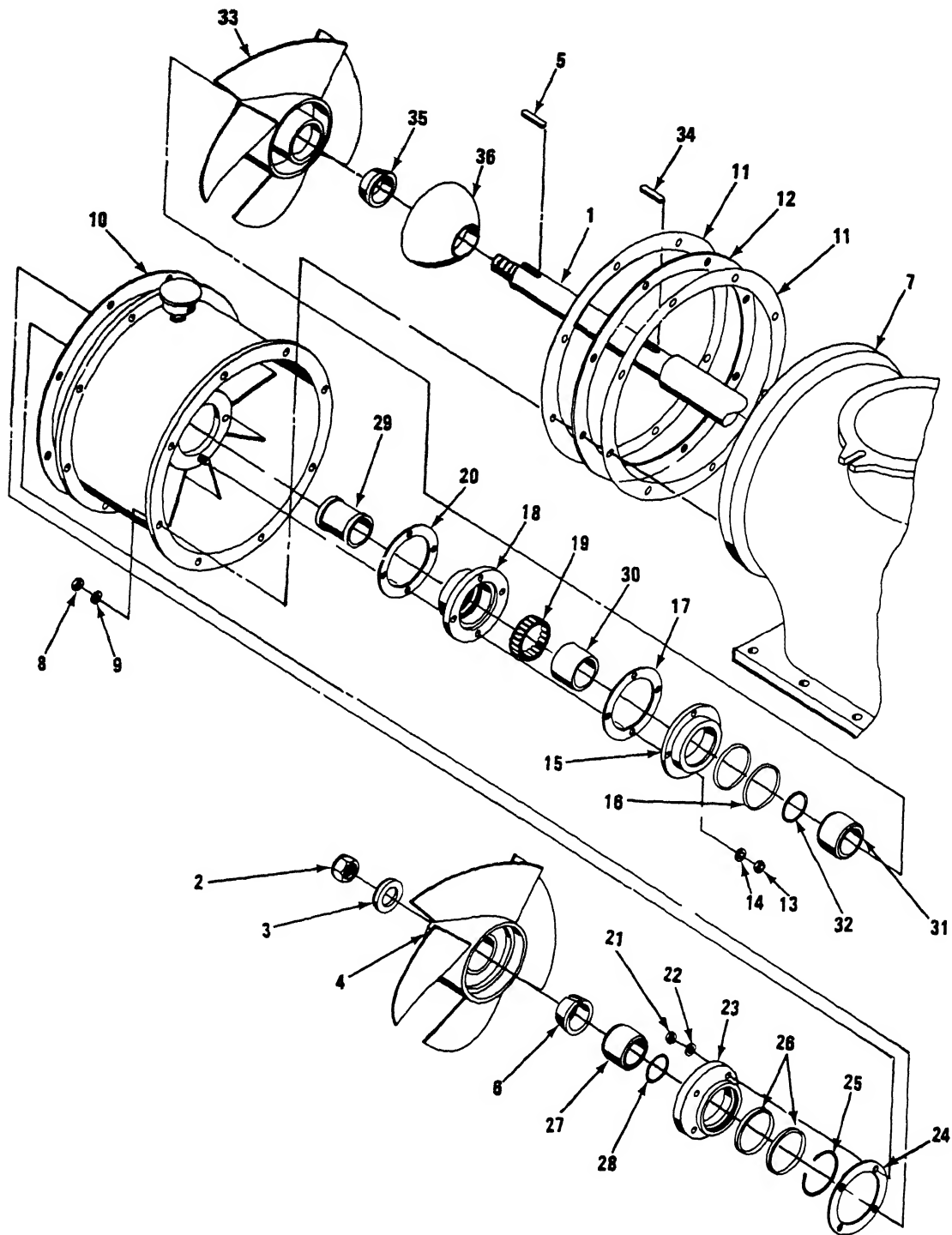
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION
(Continued)

LOCATION	ITEM	ACTION	REMARKS
14.	Front reaction case (10)	Inspect case for wear in impeller action area. Replace the case if groove is over .0787 inch (2 mm) deep.	Normally both cases would be replaced at the same time.
15.	Bearing (19)	a Inspect bearing for cracks, broken needles or discoloration b Replace if bearing found damaged.	
<u>ASSEMBLY</u>			
16 Intake case (7)	a Gasket (11)	Smear with grease and mount	
	b Insulating ring (12)	Install	
	c Gasket (11)	Smear with grease and mount	
NOTE			
Before next step pack interior cavity of reaction case with grease			
	d Reaction case (10)	Carefully slide case assembly over shaft into positioning grease fitting on top.	Do not use force as this could damage seals. If case does not slide easily work seals carefully over obstruction.

HYDROJET ASSEMBLY REPAIR (Continued) (NS - TWO STAGE IMPELLER SECTION)

LOCATION	ITEM	ACTION	REMARKS
	e. 8 washers (9) and 8 nuts retaining reaction case	Install and tighten.	Use 12 mm wrench.
17. Hydrojet assembly shaft (1)	a. Fairing (36)	Slide on shaft.	Shaft may be greased for ease of fitting.
	b. Impeller cone (35)	Slide on shaft.	Cone base forward.
	c. Key (34)	Place in groove on shaft	
	d. Front impeller (33)	Slide on shaft and fit over key	Protruding collar should be toward fairing
18 Seal sleeve (31)	O-ring (32)	Fit O-ring	
19 Hydrojet assembly shaft (1)	a. Seal sleeve (31)	Slide on shaft	
	b. Bearing inner race (30)	Slide on shaft	
	c. Spacer (29)	Slide on shaft	
20 Seal sleeve (27)	O-ring (28)	Fit to sleeve	
21 Hydrojet assembly shaft (1)	Seal sleeve (27)	Slide on shaft	

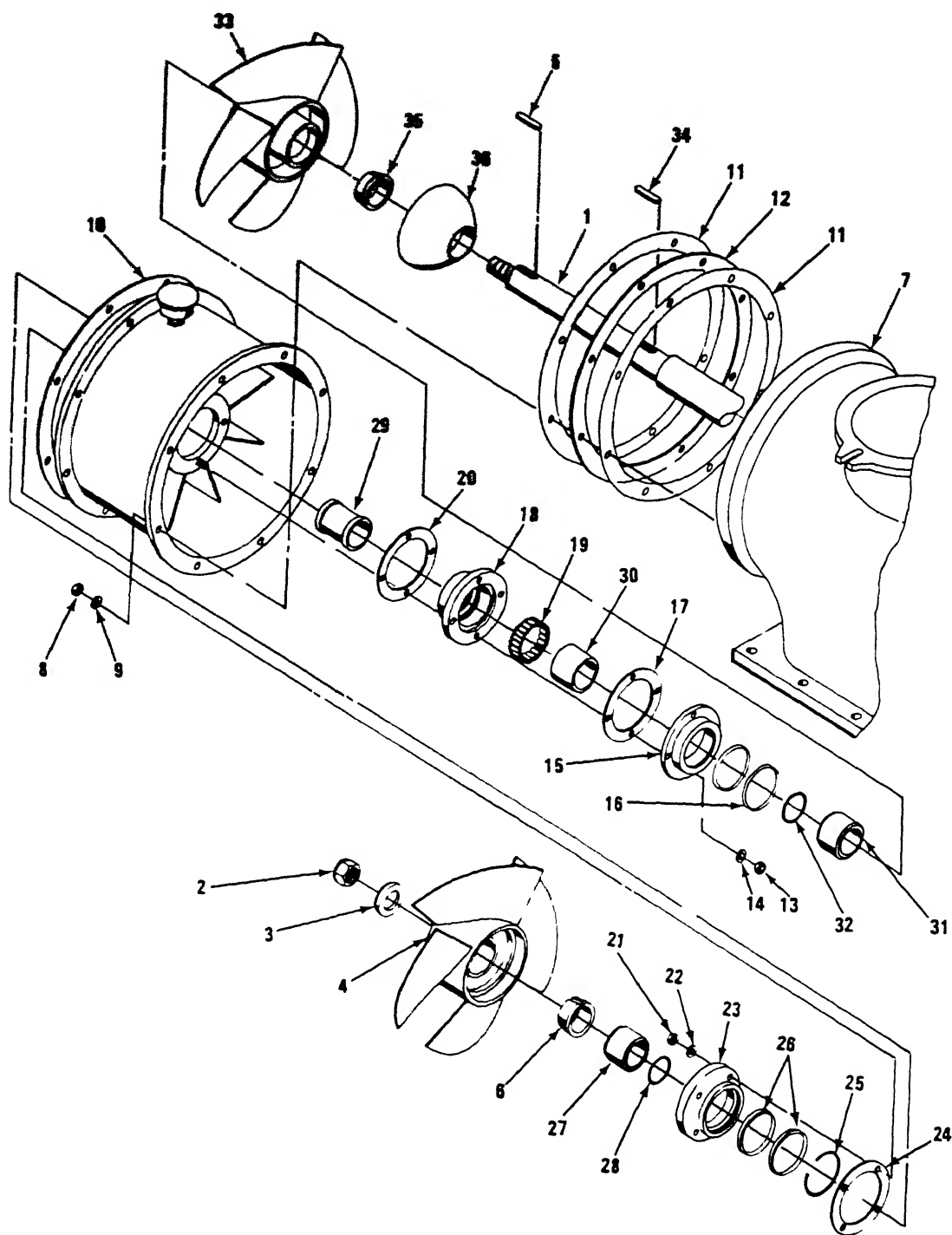
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION
(Continued)

LOCATION	ITEM	ACTION	REMARKS
22. Seal housing (23)	a. 2 seals (26)	Install.	Seal lip away from case center. Snap ring groove goes toward case center.
	b. Snap ring (25)	Install	There is groove on inside diameter of housing for ring to fit into.
23 Front reaction case (10)	a Seal housing gasket (24)	Smear with grease and mount	
	b Seal housing (23)	Install	
	c Seal housing retaining washer (22), nut (21)	Install and tighten	Use 13 mm open end wrench
24 Bearing housing (18)	Bearing (19)	Pack with grease and fit bearing to housing	Make certain all needles are installed
25 Seal housing (15)	Seal (16)	Install	Lip away from case center. Housing mounts with shoulder away from case
26 Front reaction case (10)	a Bearing housing gasket (20)	Smear with grease and mount	
	b. Bearing housing (18)	Install	

HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION (Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE IMPELLER SECTION
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	c. Seal housing gasket (17)	Smear with grease and mount.	
	d. Seal housing (15)	Install.	
	e. 4 washers (14) and 4 nuts (13) retaining seal housing	Install and tighten	Use 13 mm open end wrench.
27. Hydrojet assembly shaft (1)	a. Impeller cone (6)	Slide on shaft	Cone base first
	b. Key (5)	Install	
	c. Rear impeller (4)	Slide on shaft	Impeller collar is pointing out
NOTE			
Before next step put nonhardening Loctite on shaft threads			
	d. Washer (3) and nut (2)	a. Install and tighten	Use 30 mm socket, strap wrench, and torque wrench
		b. Hold drive flange at other end of shaft.	
		c. Torque to 150 ft-lb	

HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION

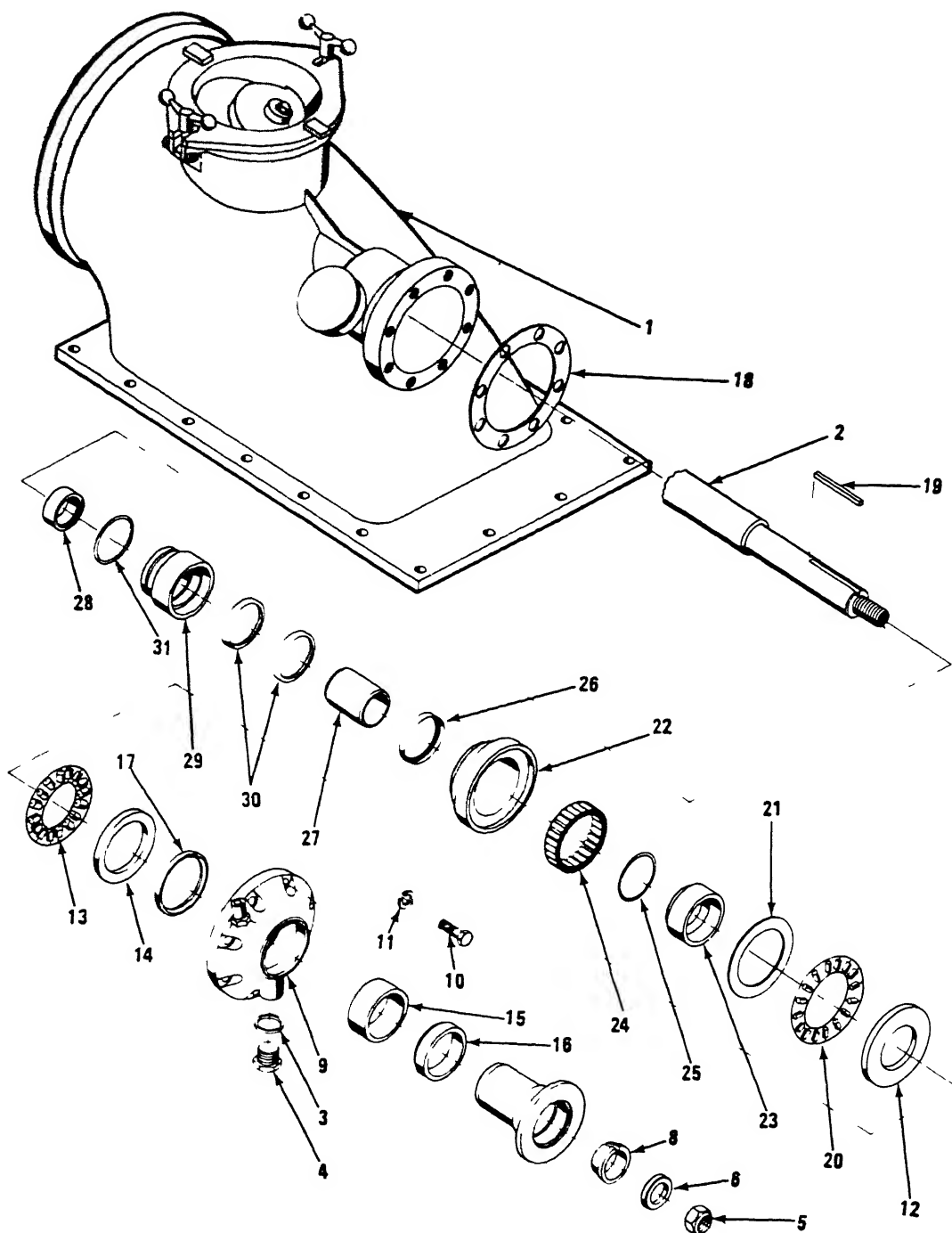
This task covers

- | | |
|----------------|------------|
| a. Disassembly | c Repair |
| b Inspection | d Assembly |

INITIAL SETUP

Tools	Equipment Condition	Condition Description
30 mm socket	Page 2-353	Hydrojet assembly
Ratchet		removed from boat
Torque wrench (0 - 175 ft-lb)	Page 3-165	Hydrojet assembly two
8 mm hex key wrench (Allen)		stage impeller section
17 mm open/box wrench		disassembled
13 mm open/box wrench		
Hammer, ball peen		
Drift, 6 in		
1-1/16 in open end wrench		
Strap wrench		
Bearing puller		
Feeler gage		
Materials/Parts		
Gaskets		
Shaft seals		
O-rings		
Personnel Required	Two	

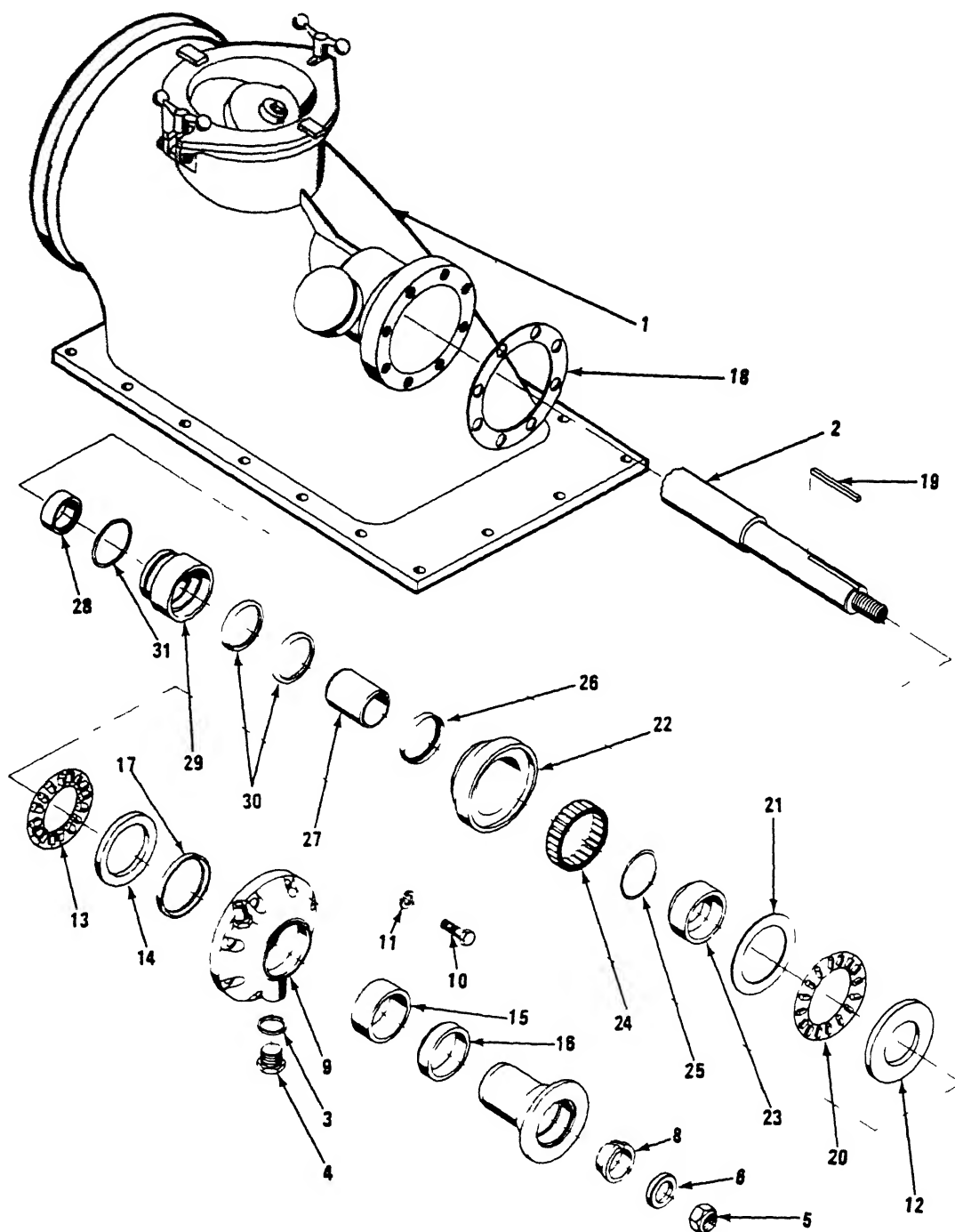
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION (Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)

LOCATION	ITEM	ACTION	REMARKS
<u>DISASSEMBLY</u>			
1	Intake case (1)	a Hydrojet assembly shaft (2)	Place support under rear end of shaft Keeps shaft level when forward supports are loosened
		b Washer (3) and plug (4)	a Remove Use 1-1/16 in wrench
		b Catch oil in suitable container	Case contains approximately 1/2 pint
2	Hydrojet assembly shaft (2)	a Shaft nut (5) and washer (6)	Hold drive flange (7) and remove nut and washer Use 30 mm socket and ratchet. Use strap wrench to hold flange
		b Drive flange (7)	Tap back and forward to loosen cone (8) Use hammer
		c Drive flange cone (8)	Remove
3	Bearing cap (9)	a 8 socket head screws (10), 8 washers (11)	Remove Use 8 mm hex key wrench (Allen)
		b Bearing cap (9)	Tap lightly and remove flange (7) and bearing assembly Use hammer Bearing assembly contains main thrust washer, thrust bearing, front thrust washer, front seal sleeve, spacer

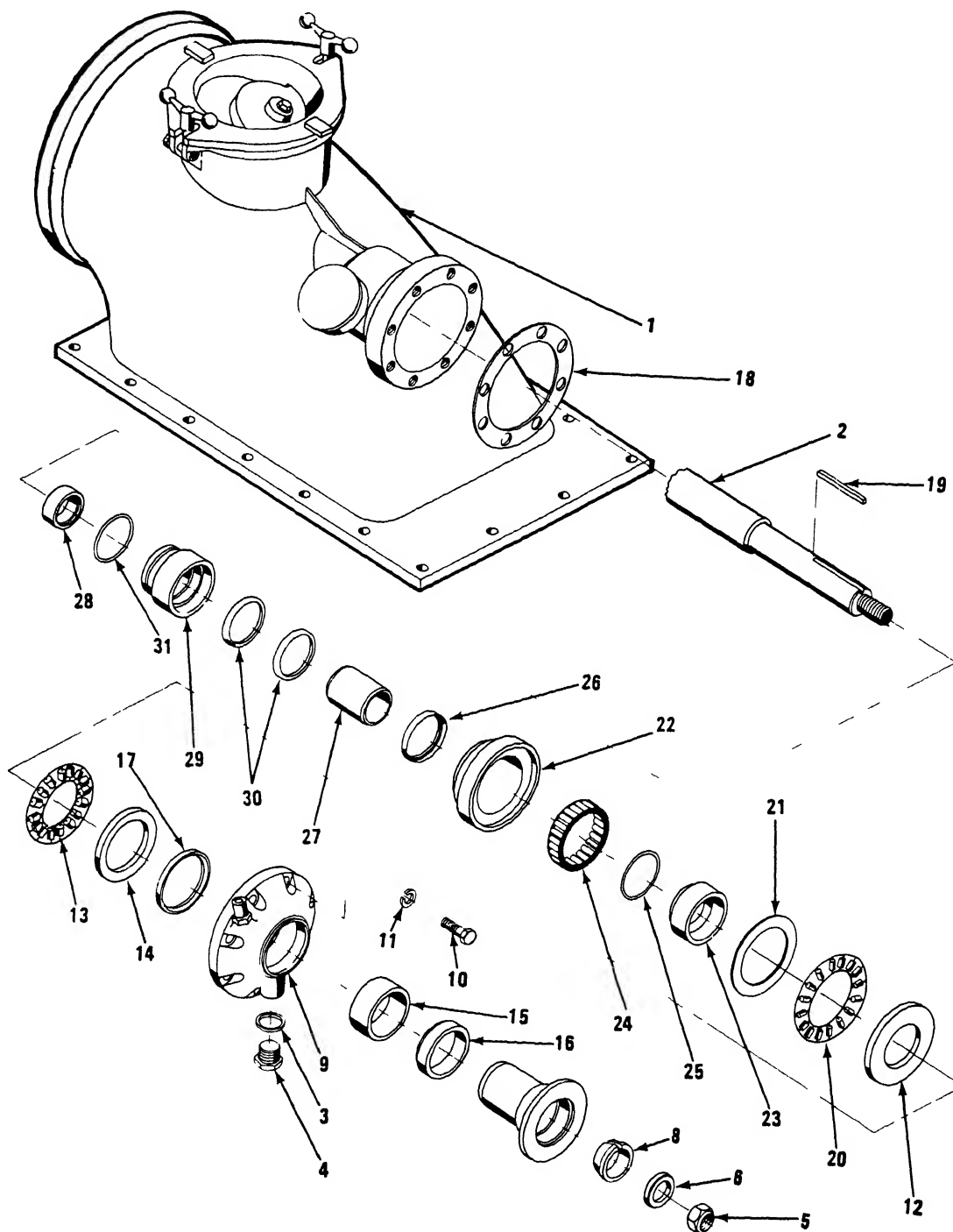
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)

LOCATION	ITEM	ACTION	REMARKS	
	c. Drive flange (7)	Slide drive flange out and then remove in order main thrust washer (12), thrust bearing (13), front thrust washer (14), spacer (15), and front seal sleeve (16)	Lay parts in order or tag for identification.	
4	Bearing cap (9)	a Seal (17)	Remove	Use seal puller Note way seal is mounted
	b Gasket (18)	Remove and discard		
5	Hydrojet assembly shaft (2)	a Key (19)	Remove	Use fingers or pliers if key sticks
	b Reverse thrust bearing (20)	Remove		Slide off shaft
	c Reverse thrust washer (21)	Remove		Slide off shaft
	d Inner seal housing (22)	a Take two bearing cap retaining screws (10), screw into holes in housing		Use hand or if stuck too tight use pliers.

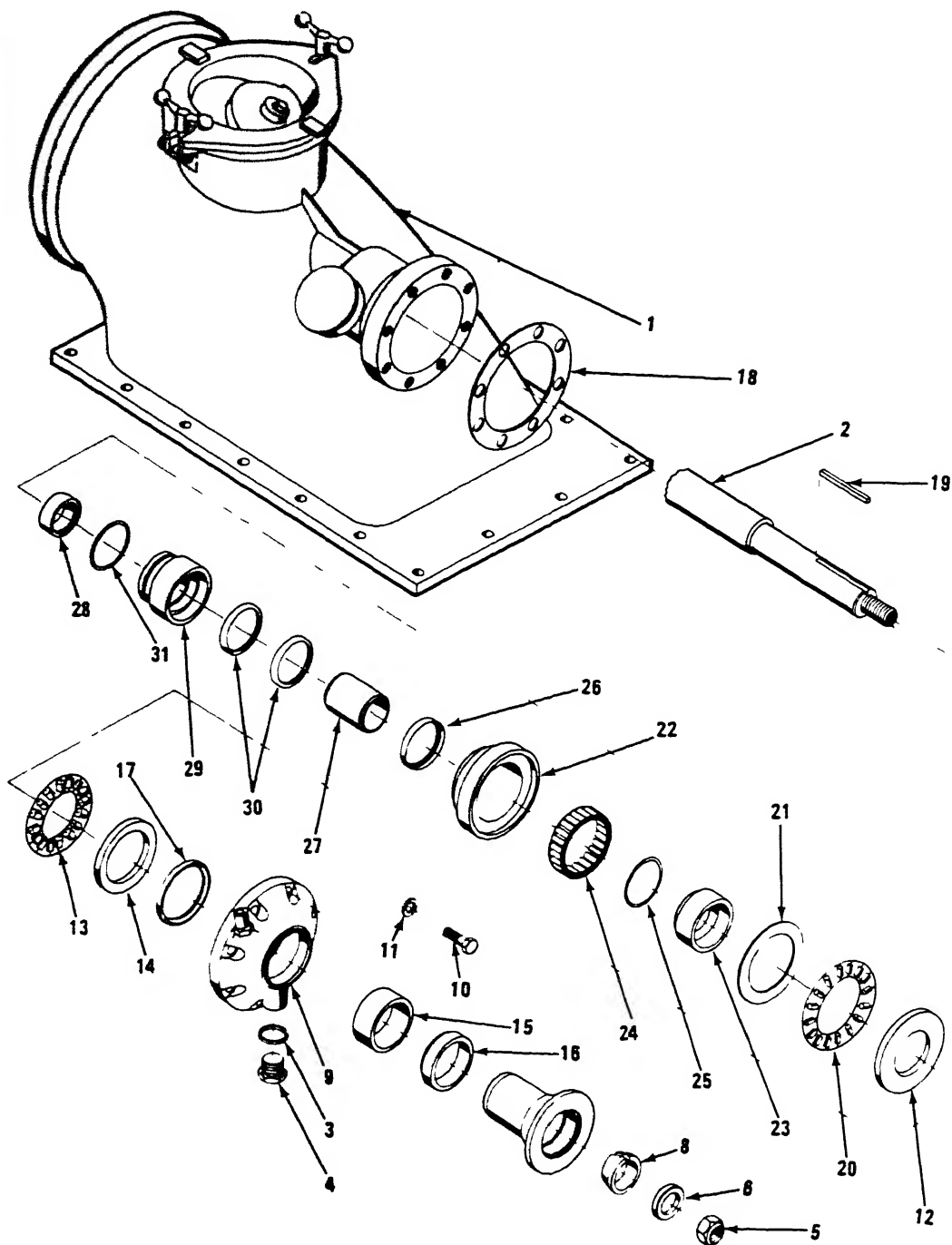
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. Pull inner seal housing out with thrust collar (23) and needle bearing (24).	
		c. Separate thrust collar from housing.	
6. Thrust collar (23)	O-ring (25)	Remove and discard.	
7. Inner seal housing (22)	a Needle bearing (24)	a. Remove from front of housing	Use bearing puller
		b Retain all bearing parts	
	b Seal (26)	Remove from rear of housing and discard	Use seal puller Note how seal is positioned
8 Hydrojet assembly shaft (2)	Seal sleeve (27)	Slide off shaft	
9 Intake case (1)	a Hydrojet assembly shaft (2) and plain sleeve (28)	a Remove shaft by sliding toward rear of intake case.	Plain sleeve (28) will slide out along with shaft
		b Slide sleeve off shaft after removal	

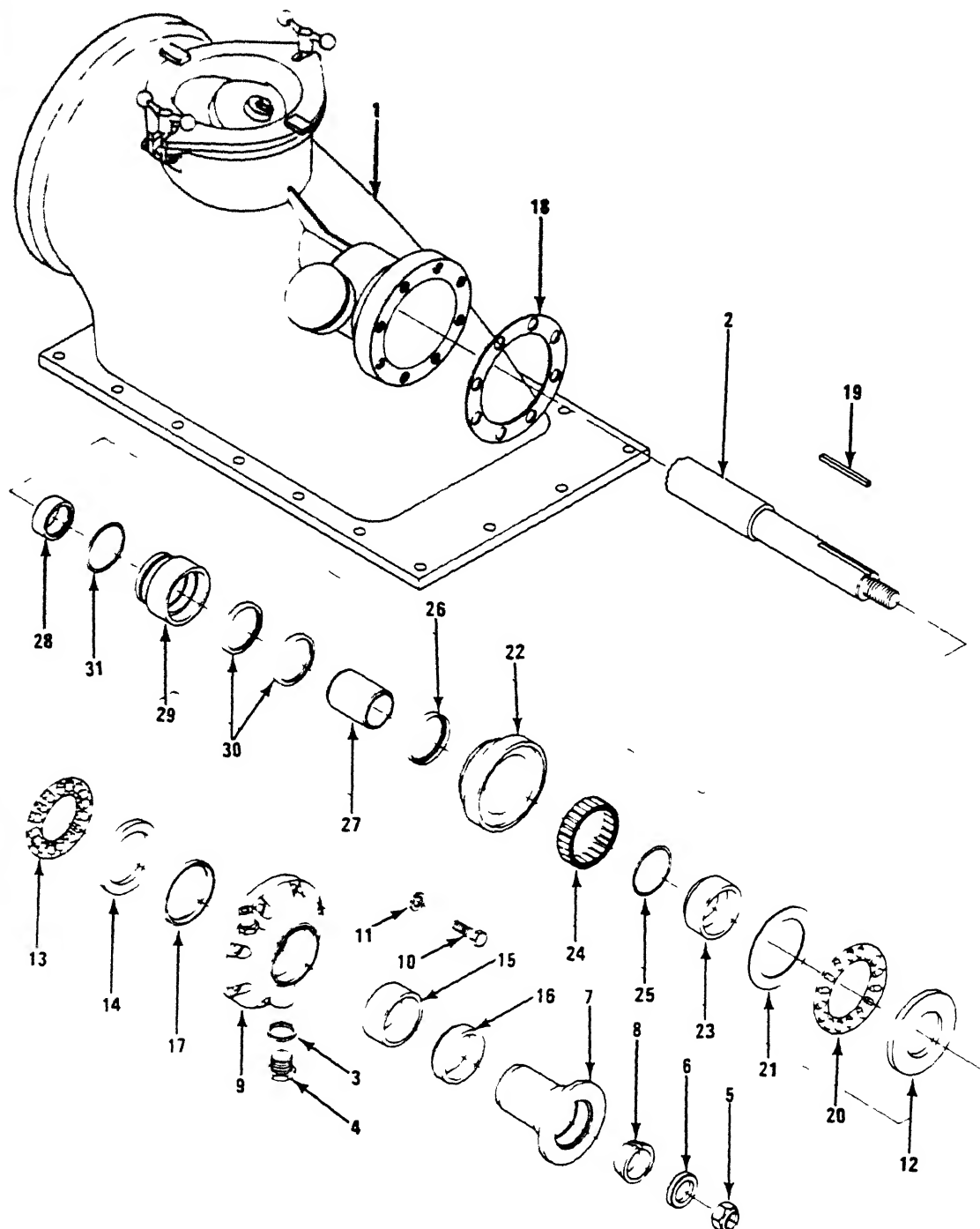
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)

LOCATION	ITEM	ACTION	REMARKS
	b Seal housing (29)	Tap out from rear toward front	Use hammer and drift
	c Seals (30)	Remove and discard	Use seal puller
	d O-ring (32)	Remove from outer diameter of housing and discard	
<u>INSPECTION AND REPAIR</u>			
10	Bearings (13, 20, 24)	a Inspect for cracks or chipped rollers or discoloration	
		b Replace bearing if cracked, chipped or discolored	
11	Main thrust washer (12)	a Inspect for cracks, visible steps between used and unused portion or discoloration	
		b Measure washer thickness Thickness should be not less than 4091 inch (0161 mm)	Use feeler gage

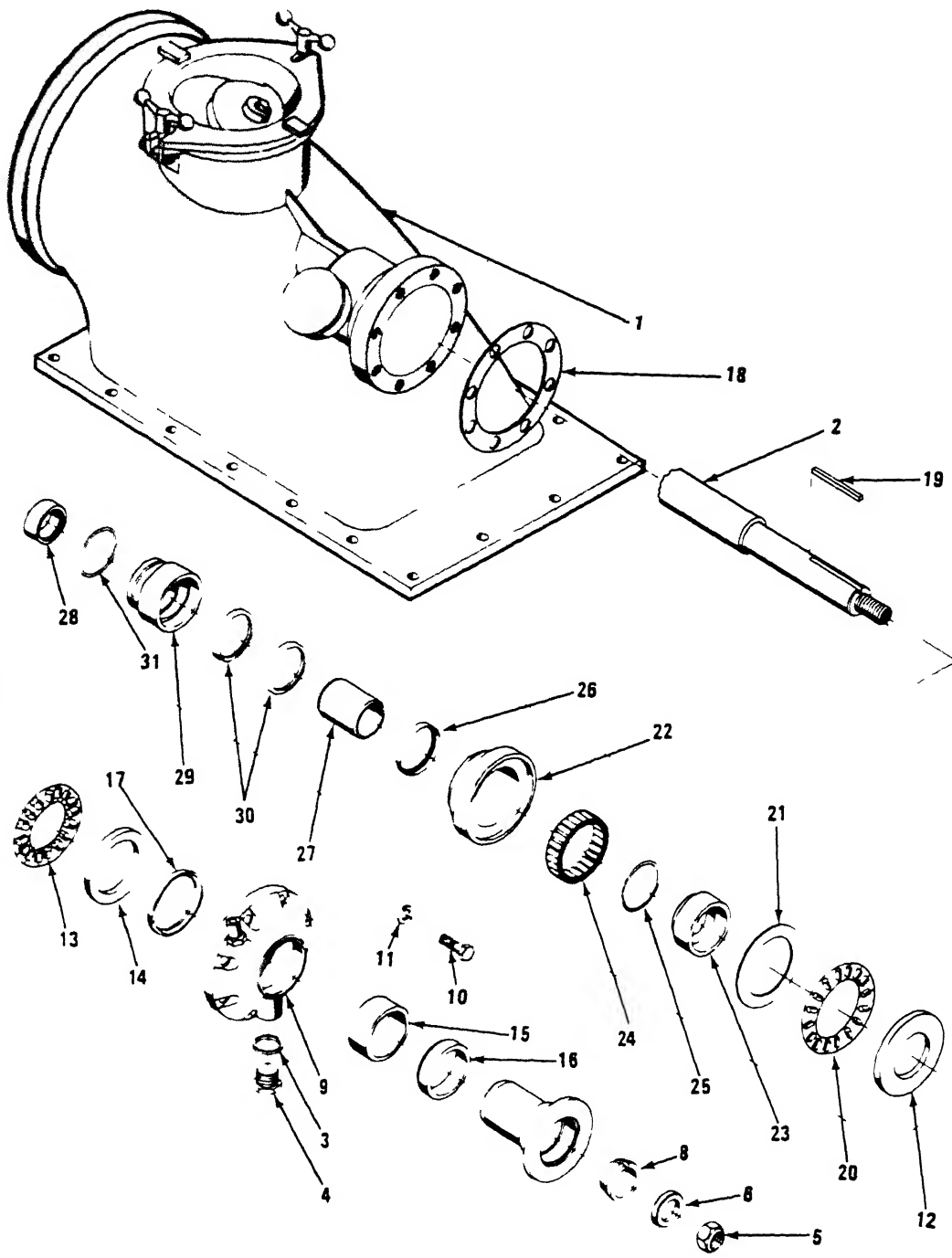
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION (Continued)

LOCATION	ITEM	ACTION	REMARKS
12	Reverse thrust washer (21)	c. Replace if cracked, stepped, discolored from overheating or not thick enough	
		a Inspect for cracks, visible steps between used and unused portion or discoloration	
		b Measure washer Use feeler gage thickness Thickness should be 0414 to 0374 inch (1 05 to 0 95 mm)	
13	Front thrust washer (14)	c Replace if cracked, stepped, discolored from overheating or not thick enough	
		a Inspect for cracks, visible steps between used and unused portion or discoloration	
		b Measure washer Use feeler gage thickness Thickness should be not less than 3115 inch (7 91 mm)	

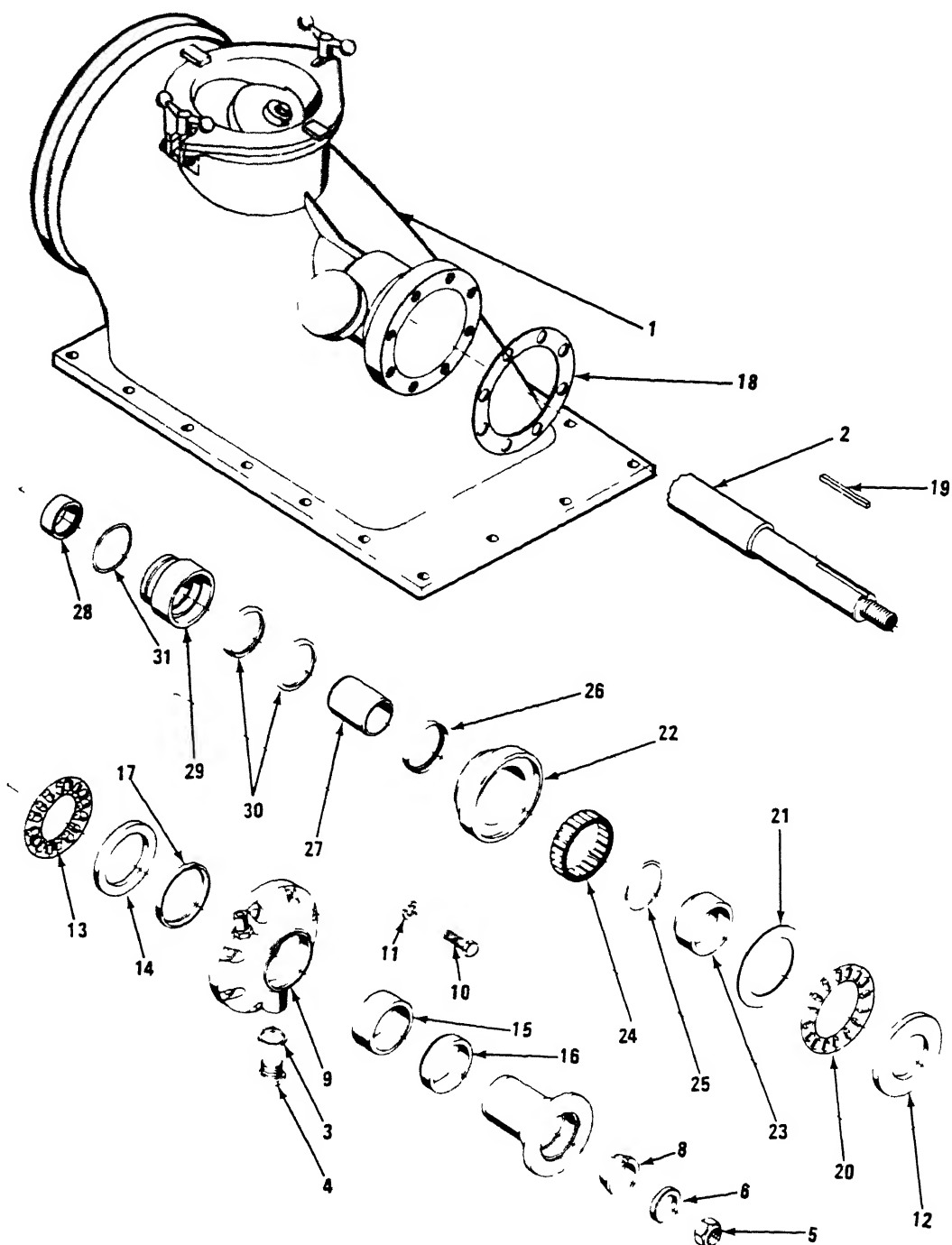
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION (Continued)

LOCATION	ITEM	ACTION	REMARKS
14.	Thrust collar (23), seal sleeves (16 and 27), plain sleeves (28)	c Replace if cracked, stepped, discolored from overheating or not thick enough.	
		a Inspect for cracks	
		b Replace if cracked	
		c Polish with crocus cloth to clean	
<u>ASSEMBLY</u>			
15 Seal housing (29)	a O-ring (31)	Fit on housing	Use new O-ring
	b Seals (30)	Fit into housing	Use new seals Lip points to smaller housing diameter
16 Intake case (1)	Seal housing (29)	a Fit into housing	Use drift and hammer
		b Insert from front toward rear	
		c If necessary tap lightly to seat	

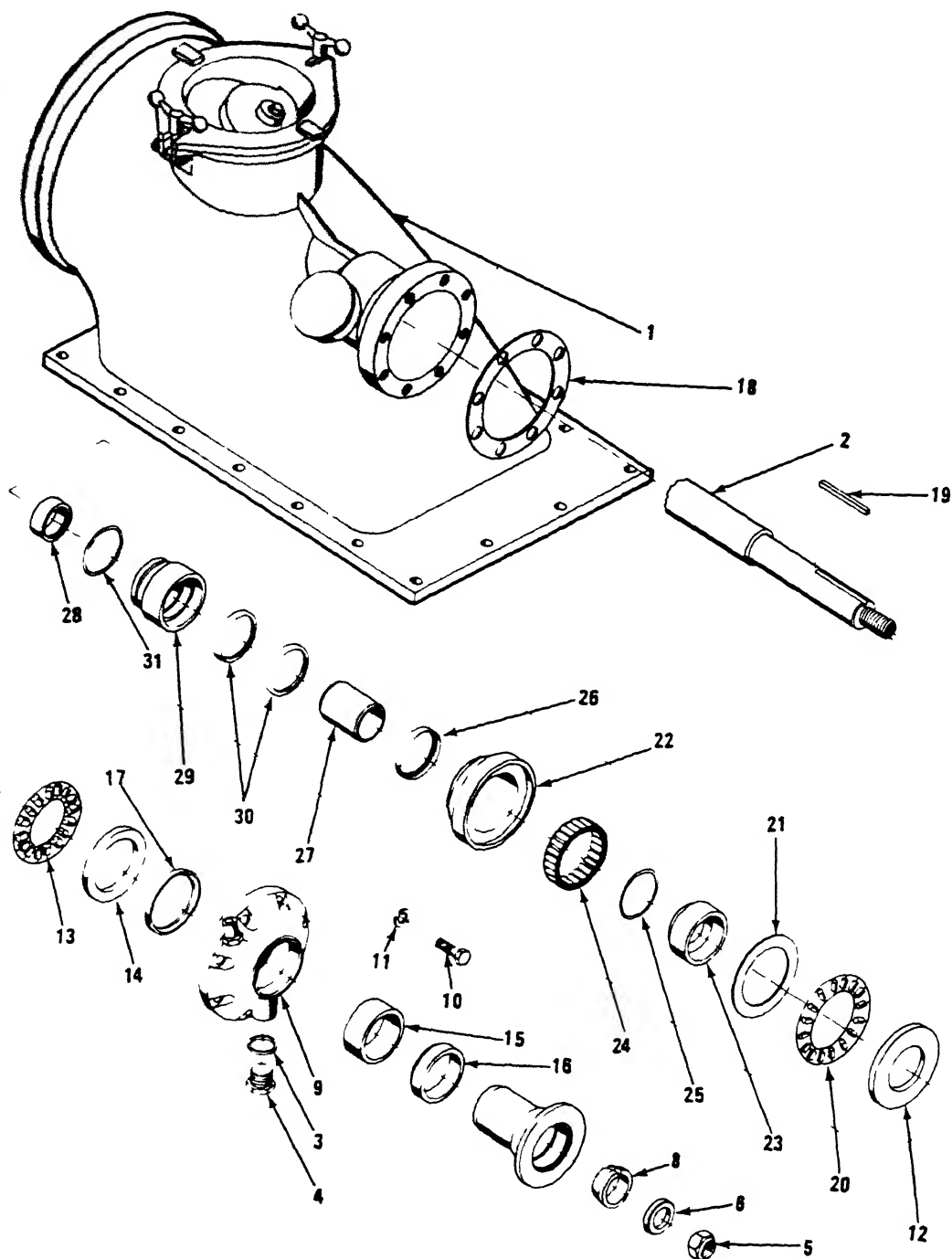
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION (Continued)

LOCATION	ITEM	ACTION	REMARKS
17	Hydrojet assembly shaft (2)	Plain sleeve (28)	Slide on shaft.
18.	Intake case (1)	Hydrojet assembly shaft (2)	Fit into case from rear. Support at end as in disassembly
19	Hydrojet assembly shaft (2)	Seal sleeve (27)	Slide on shaft
NOTE			
Pack cavity around seal housing with grease and remove bearing grease cap (32) to relieve pressure before next step			
20	Inner seal housing (22)	a Needle bearing (24)	Fit into housing Fits in front Grease to hold in position
		b Shaft seal (26)	Fit into housing Use new seal Position lip toward large diameter
21	Intake case (1)	Inner seal housing (22)	a Fit into case b Slide on over shaft
22	Thrust collar (23)	O-ring (25)	Fit to collar Use new O-ring
23	Hydrojet assembly shaft (2)	a Thrust collar (23)	Fit over shaft
		b Thrust washer (21)	a Fit over shaft on outside of needle bearing

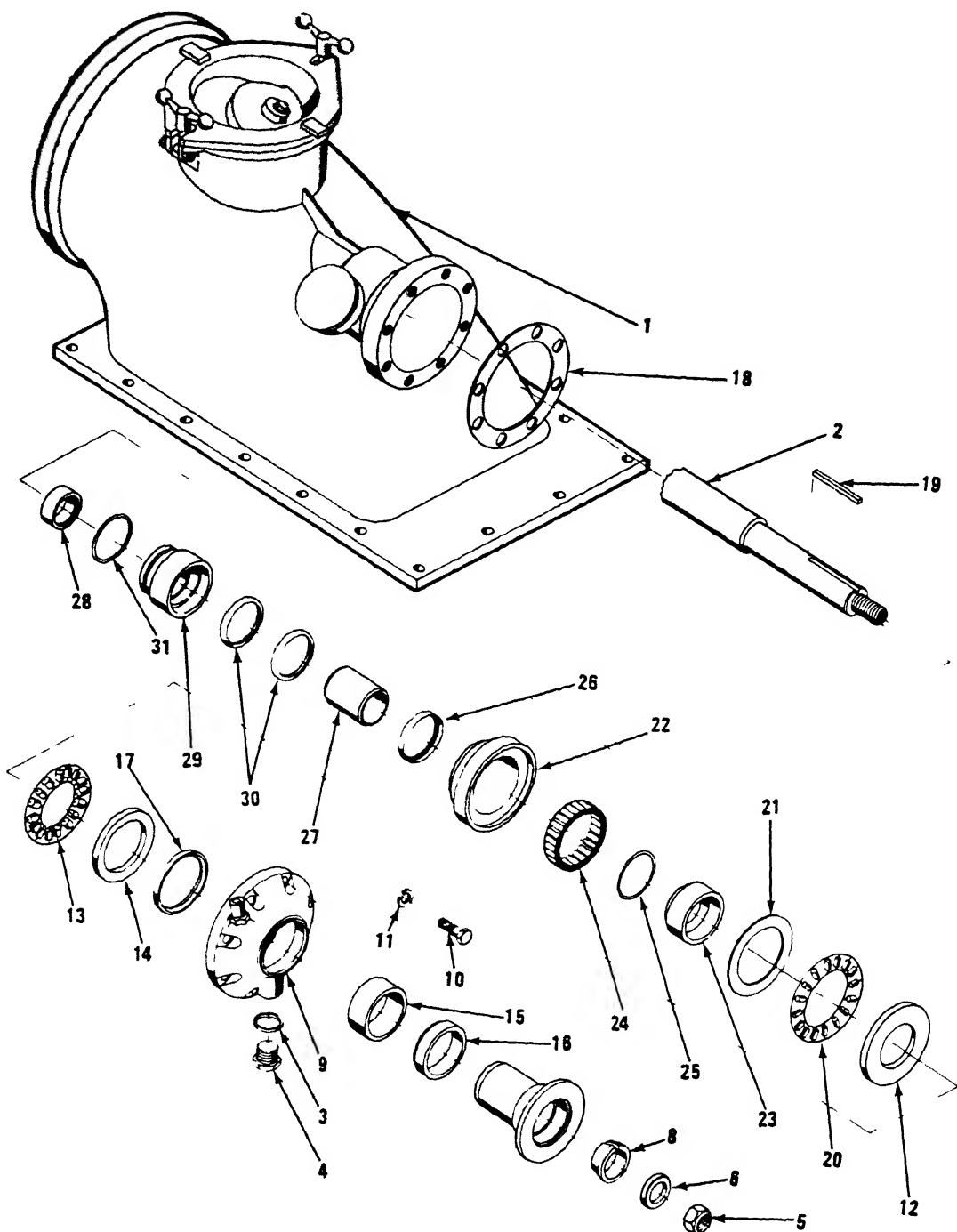
HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION (Continued)

LOCATION	ITEM	ACTION	REMARKS	
		b. Grease lightly to hold.		
	c. Reverse thrust bearing (20)	a. Fit over shaft on outside of needle bearing.		
		b. Grease lightly to hold in position.		
24	Bearing cap (9)	a. Seal (17)	Fit into cap	Use new seal Position lip toward open face of cap
	b. Gasket (18)	a. Lightly grease and stick to cap		
		b. Align bolt holes		
25	Drive flange (7)	a. Seal sleeve (16)	Slide on flange	
	b. Bearing cap (9)	Slide over seal sleeve on flange.		
	c. Spacer (15)	Slide on flange		
	d. Thrust washer (14)	Fit into bearing cap.		
	e. Thrust bearing (13)	a. Fit into bearing cap.		

HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)



HYDROJET ASSEMBLY REPAIR INSTRUCTIONS - TWO STAGE DRIVE SECTION
(Continued)

LOCATION	ITEM	ACTION	REMARKS
		b. Grease to hold in position.	
		J	
	f Main thrust washer (12)	Fit into bearing cap.	
26. Hydrojet assembly shaft (2)	a. Key (19)	Fit into groove on shaft	
	b Bearing cap (9) subassembly	Slide on shaft	Assembly includes drive flange
27 Bearing cap (9)	8 washers (11) and 8 socket head screws (10)	Install	When installing cap make sure oil connection is straight up
28 Hydrojet assembly shaft (2)	a. Drive flange cone (8)	Slide over shaft and key	
	b Washer (6) and main shaft nut (5)	a Put nonhardening locktite on threads and install washer and nut	Flange side of washer goes toward cone (18)
		b Tighten to 150 ft-lb	
29 Bearing cap (9)	Washer (3) and plug (4)	Install in cap (9)	

APPENDIX A

REFERENCES

Fire Protection

5-4200-200-10 Hand Portable Fire Extinguishers Approved for Army Users

Lubrication

100-IL Identification List for Fuels, Lubricants, Oils and Waxes

5-1940-277-12/
1940-12 Lubrication Order

Maintenance

43-0139 Painting Instructions for Field Use

750-651 K Use of Antifreeze Solutions and Cleaning Compounds in Cooling System

Pam 738-750 The Army Maintenance Management System (TAMMS)

5-1940-277-20 Organizational Maintenance Manual for Boat, Bridge Erection, Twin Jet, Aluminum Hull, Models USCSBMK1 and USCSBMK2

5-1940-277-20P Organizational Repair Parts and Special Tools List for Boat Bridge Erection, Twin Jet, Aluminum Hull, Models USCSBMK1 and USCSBMK2

5-1940-277-34P Direct and General Support Repair Parts and Special Tools List for Boat, Bridge Erection, Twin Jet, Aluminum Hull, Models USCSBMK1 and USCSBMK2

9-4910-458-12 Operator and Organizational Maintenance Manual, Test Stand, Automotive Generator, Alternator and Starter

9-6140-200-14 Operation and Organizational, Field, and Depot Maintenance Storage Batteries, Lead-Acid Type

9-247 Materials Used for Cleaning, Preserving, Abrading and Cementing Ordnance Material

9-214 Inspection, Care, and Maintenance of Anti-friction Bearings

TM 5-2090-202-12&P Operator and Organizational Maintenance Manual,
Cradle, Twin Jet, Bridge Erection Boat

TM 9-237 Operator's Manual for Welding Theory and
Application

TM 4700-15/1 Equipment Record Procedures

A-4. Shipment and Storage

TB 740-93-4 Preservation of Vessels for Storage

TB 55-46-1 Standard Characteristics (Dimensions, Weight,
and Cube) for Transportability of Military
Vehicles and Other Outsize/Overweight
Equipment

A-5. Destruction to Prevent Enemy Use

TM 750-244-3 Procedures for Destruction of Equipment to
Prevent Enemy Use

A-6 Forms

DA Form 2028 Recommended Changes to Publications and Blank
Forms

DA Form 2028-2 Recommended Changes to Equipment Technical
Publications

DA Form 2408-9 Equipment Control Record

MCO 1650 17 Marine Corps Military Incentive Awards Program

MCO 4855 10 Quality Deficiency Report for MC Users

NAVMC Form 10772 Recommended Changes to Technical Publications

SF 368 Quality Deficiency Report

A-7 Miscellaneous

FM 21-11 First Aid for Soldiers

APPENDIX B

EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

B-1. SCOPE

This appendix lists expendable supplies and materials you will need to operate and maintain the boat. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items)

B-2. EXPLANATION OF COLUMNS

a Column (1) - Item number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e g , Use cleaning compound, Item 5, App. B).

b Column (2) - Level This column identifies the lowest level of maintenance that requires the listed item

- C - Operator/Crew
- O - Organizational Maintenance
- F - Direct Support Maintenance
- H - General Support Maintenance

c Column (3) - National Stock Number This is the National stock number assigned to the item, use it to request or requisition the item

d Column (4) - Description Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Manufacturer (FSCM) in parentheses followed by the part number

e Column (5) - Unit of Measure (U/M) Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e g , ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1)	(2)	(3)	(4)	(5)
ITEM NUMBER	LEVEL	NATIONAL STOCK NUMBER	DESCRIPTION	U/M
1	O	9150-00-190-0907	GREASE, AUTOMOTIVE AND ARTILLERY (GAA), (81349) MIL-G-10924	CN
2	O	8030-00-889-3535	TAPE, ANTISEIZE, SIZE 11-1/2" X 260" (18876) 11072502	RO
3	O	8330-00-538-5212	SEALANT, SILICONE (71984) 732RTV	TB
4	O	8305-00-267-3015	CLOTH, COTTON, CHEESE (81348) CCCC40	YD
5	O	7930-00-249-8036	DETERGENT, GENERAL PURPOSE (81348) P-D-220	
6	C	9150-00-186-6681	OIL, ENGINE, OE/HDO-30 MIL-L-2104	QT
7	C	9150-00-189-6727	OIL, ENGINE, OE/HDO-10 MIL-L-2104	QT
8	C		FUEL, DIESEL, DF-2 VV-F-800	GA
9	O		ANTIFREEZE, ETHYLENE GLYCOL INHIBITED, HEAVY DUTY, SINGLE PACKAGE, MIL-A-46153	GA
10	O		DRY CLEANING SOLVENT	GA
11	O	7510-00-285-6403	TAPE, PSA, CELLULOSE, BLACK (83149) MIL-T-40620	RO

APPENDIX C

ILLUSTRATED LIST OF MANUFACTURED ITEMS

INTRODUCTION

This appendix includes complete instructions for making items authorized to be manufactured or fabricated at direct and general support maintenance level.

A part number index in alphanumeric order is provided for cross-referencing the part number of the item to be manufactured to the figure which covers fabrication criteria.

All bulk material needed for manufacture of an item is listed in a tabular form for each illustration.

MANUFACTURED ITEMS PART NUMBER INDEX

- C-1 Bearing Assembly Tool
- C-2 Clutch and Planetary Assembly Fixture
- C-3 Control Valve Assembly Fixture
- C-4 Pump Oil Seal Sleeve

MANUFACTURED ITEMS ILLUSTRATIONS

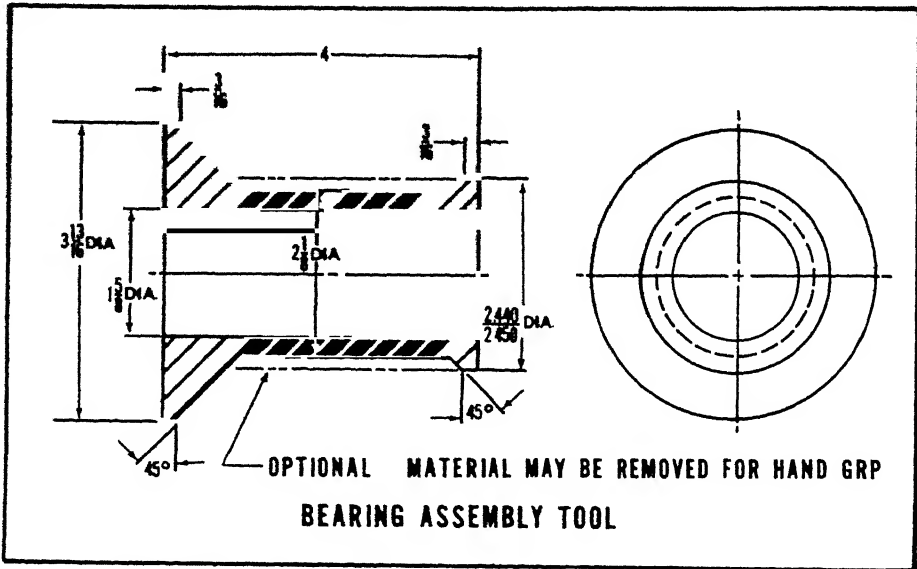


Figure C-1

Low Carbon Steel Bar 3-7/8 in diameter x 4 in long

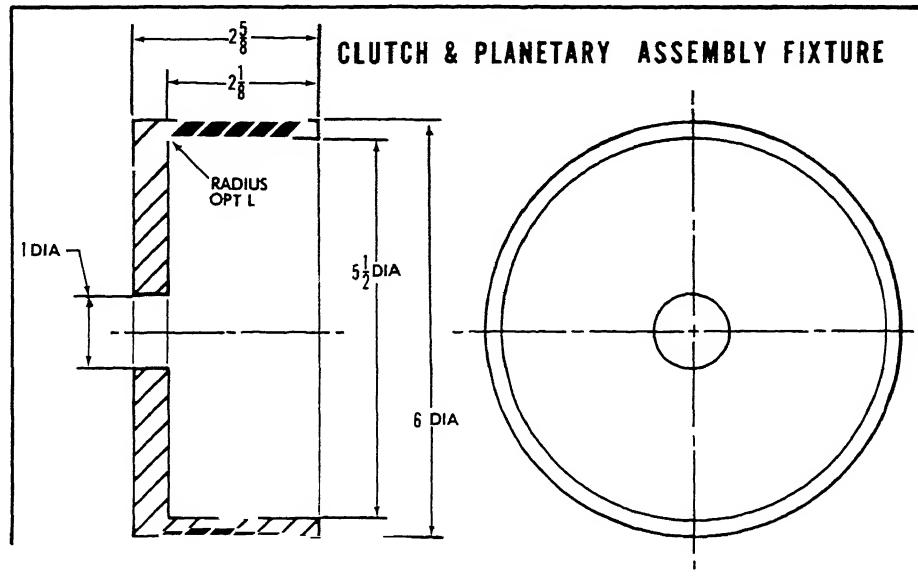


Figure C-2

Round Mechanical Tubing Carbon Steel

6 in OD x 1/4 in wall thickness x 2-1/8 in long

Carbon Steel Flat Plate 12 in x 12 in x 1/2 in thick

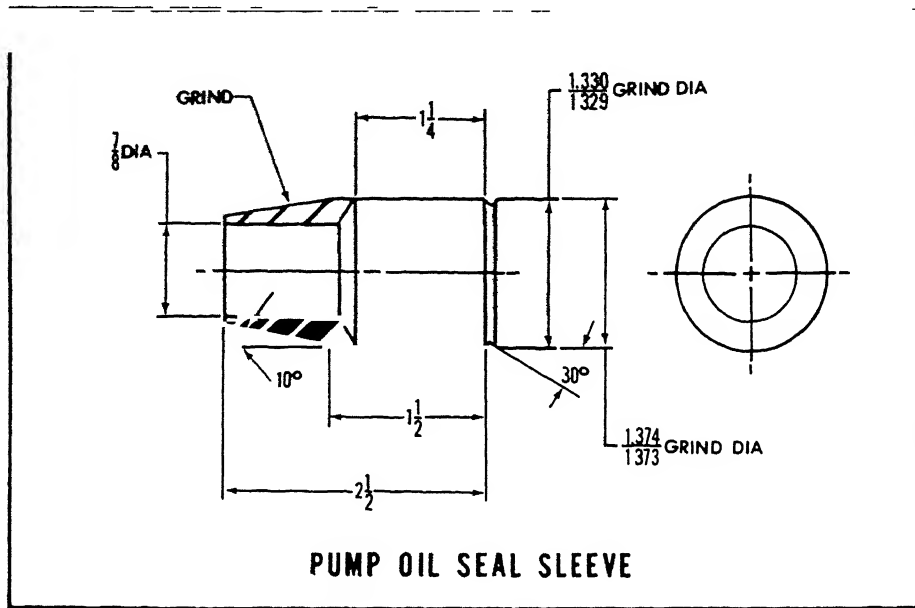


Figure C-4

Low Carbon Bar Stock $1\frac{3}{8}$ in diameter x $2\frac{1}{2}$ in long

APPENDIX D

GLOSSARY

Section I ABBREVIATIONS

cc	cubic centimeters
dc	direct current
rpm	revolutions per minute

Section II DEFINITION OF UNUSUAL TERMS

Aft - At, near or toward rear of boat

Bow - Front of boat

Forward - At or toward front of boat

Gearbox - Transmission

Hydrojet - Water jet propulsion system

Port - Left side of boat looking toward bow

Sedimenter - Fuel strainer and water collector

Starboard - Right side of boat looking toward bow

Stern - Rear of boat

Tachgenerator - Low voltage generator whose output indicates engine rpm

Thermostart unit - A combined fuel jet and glow plug used to pre-heat air going into intake manifold

Transom - Stern structural member of boat

ALPHABETICAL INDEX

Subject, Page

A

Alternator, repair, 2-57

C

Cam follower, inspection and replacement, 3-5
 Camshaft, replacement, inspection and repair, 3-75
 Camshaft bearing, inspection and replacement, 3-75
 Control box, replacement, 2-145
 Crankshaft, inspection and replacement, 3-57
 Cylinder head assembly, inspection and repair, 2-277
 Cylinder head assembly replacement, 2-291
 Cylinder head assembly, valve spring, replacement, 2-301
 Cylinder liner, inspection and replacement, 3-37

D

Drain down valve, replacement (MK1) 2-51

E

Engine assembly, replacement, 2-179
 Engine assembly, test, 2-173
 Engine block repair, 3-87
 Engine mounts and brackets, replacement 2-161
 Engine wiring harness, repair, 2-109
 Engine wiring harness, replacement, 2-93
 Engine wiring interconnect harness, replacement, 2-115

Subject, Page

F

Flywheel and housing, replacement, 2-317
 Fuel tank, replacement, 2-39

H

Hull assembly, repair, 2-423
 Hydrojet assembly, two stage drive section, repair, 3-183
 Hydrojet assembly, two stage impeller section, repair, 3-165
 Hydrojet assembly, replacement, 2-353

I

Injection pump, replacement, 2-245
 Injector, repair, 2-261

M

Main bearing, replacement, 3-47
 Mast wiring harness, lower, replacement, 2-121
 Mast wiring harness, upper, replacement, 2-133

O

Oil pump, replacement, 3-9
 Oil sump, replacement, 2-307

P

Piston and connecting rod assembly, inspection and repair, 3-15
 Piston and connecting rod assembly, replacement, 3-29

Order of the Secretary of the Army

E C MEYER
General, United States Army
Chief of Staff

ial

ROBERT M JOYCE
Adjutant General, United States Army
The Adjutant General

DISTRIBUTION

be distributed in accordance with DA Form 12-25D, Direct and General Support
Maintenance Requirements for Special Equipment, Boat Bridge Erection

*U S GOVERNMENT PRINTING OFFICE 1990--261-888/08434



RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH THIS PUBLICATION?



THEN JOT DOWN THE
NOTE ABOUT IT ON THIS
FORM CAREFULLY TEAR IT
OUT FOLD IT AND DROP IT
IN THE MAIL

FROM (PRINT YOUR UNIT'S COMPLETE ADDRESS)

PFC JOHN DOE
COA, 3d ENGINEER BN
FT. L. BARNWOOD, MD 63108

DATE SENT

PUBLICATION NUMBER
TM 5-1940-277-34

PUBLICATION DATE
10 Nov 81

PUBLICATION TITLE
Boat, Bridge Erection, Twin Jet,
Aluminum Hull

BE EXACT PIN-POINT WHERE IT IS

PAGE NO	PARA GRAPH	FIGURE NO	TABLE NO
6	2-1 a		
B1		4-3	
125	line 20		

IN THIS SPACE TELL WHAT IS WRONG
AND WHAT SHOULD BE DONE ABOUT IT

In line 6 of paragraph 2-1a the
manual states the engine has
6 Cylinders. The engine on my
set only has 4 Cylinders.
Change the manual to show 4
Cylinders.

Callout 16 on figure 4-3 is
pointing at a bolt. In key
to figure 4-3, item 16 is called
a shim. Please correct
one or the other

I ordered a gasket, item
19 on figure B-16 by NSN
2 910-00-762-3001. I got a
gasket but it doesn't fit.
Supposedly I got what
I ordered, so the NSN is
wrong. Please give me a
good NSN

PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER

JOHN DOE, PFC (268) 317-7111

SIGN HERE

JOHN DOE

DA FORM 2028-2
1 JUL 79

PREVIOUS EDITIONS
ARE OBSOLETE
DRSTS-M Overprint 1 1 Nov 80

PS IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR
RECOMMENDATION MAKE A CARBON COPY OF THIS
AND GIVE IT TO YOUR HEADQUARTERS

FILL IN YOUR
UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD 314



OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE \$300

COMMANDER
U S ARMY SUPPORT AND AVIATION MATERIEL READINESS COMMAND
ATTN DRSTS-MTT
4300 GOODFELLOW BOULEVARD
ST LOUIS MO 63120

TEAR ALONG PERFORATED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



THEN JOT DOWN THE
DOPE ABOUT IT ON THIS
FORM. CAREFULLY TEAR IT
OUT FOLD IT AND DROP IT
IN THE MAIL

SOMETHING WRONG WITH THIS PUBLICATION?

FROM (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER

TM 5-1940-277-34

PUBLICATION DATE

10 Nov 81

PUBLICATION TITLE

Boat, Bridge Erection, Twin Jet,
Aluminum Hull

BE EXACT PIN-POINT WHERE IT IS

PAGE
NO

PARA
GRAPH

FIGURE
NO

TABLE
NO

IN THIS SPACE TELL WHAT IS WRONG
AND WHAT SHOULD BE DONE ABOUT IT

PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER

SIGN HERE

DA FORM 2028-2
1 JUL 79

PREVIOUS EDITIONS
ARE OBSOLETE
DRSTS-M Overprint 2, 1 Nov 80.

P.S. IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR
RECOMMENDATION MAKE A CARBON COPY OF THIS
AND GIVE IT TO YOUR HEADQUARTERS

17 4K 4100C P100041D (1-7)

FILL IN YOUR
UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD 314



OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE \$300

COMMANDER
U S ARMY SUPPORT AND AVIATION MATERIEL READINESS COMMAND
ATTN DRSTS-MTT
4300 GOODFELLOW BOULEVARD
ST LOUIS MO 63120

TEAR ALONG PERFORATED LINE

SOMETHING WRONG WITH THIS PUBLICATION?

DATE SENT

PUBLICATION TITLE

Boat, Bridge Erection, Twin Jet,
Aluminum Hull

**IN THIS SPACE TELL WHAT IS WRONG
AND WHAT SHOULD BE DONE ABOUT IT**

TABLE
NO

SIGN HERE

PS IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR
RECOMMENDATION MAKE A CARBON COPY OF THIS
AND GIVE IT TO YOUR HEADQUARTERS

FILL IN YOUR
UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD 314



OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE \$300

COMMANDER
U S ARMY SUPPORT AND AVIATION MATERIEL READINESS COMMAND
ATTN DRSTS-MTT
4300 GOODFELLOW BOULEVARD
ST LOUIS MO 63120

TEAR ALONG PERFORATED LINE



THEN JOT DOWN THE
DOPE ABOUT IT ON THIS
FORM CAREFULLY TEAR IT
OUT FOLD IT AND DROP IT
IN THE MAIL

SOMETHING WRONG WITH THIS PUBLICATION?

FROM (PRINT YOUR UNIT S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER
M 5-1940-277-34

PUBLICATION DATE
10 Nov 81

PUBLICATION TITLE
Boat, Bridge Erection, Twin Jet,
Aluminum Hull

BE EXACT PIN-POINT WHERE IT IS

PAGE NO	PARA GRAPH	FIGURE NO	TABLE NO
------------	---------------	--------------	-------------

IN THIS SPACE TELL WHAT IS WRONG
AND WHAT SHOULD BE DONE ABOUT IT

PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER

SIGN HERE

A FORM 2028-2
1 JUL 79

PREVIOUS EDITIONS
ARE OBSOLETE
DRSTS-M Overprint 2, 1 Nov 80

PS IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR
RECOMMENDATION MAKE A CARBON COPY OF THIS
AND GIVE IT TO YOUR HEADQUARTERS



FILL IN YOUR
UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD 314



OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE \$300

COMMANDER
U S ARMY SUPPORT AND AVIATION MATERIEL READINESS COMMAND
ATTN DRSTS-MTT
4300 GOODFELLOW BOULEVARD
ST LOUIS MO 63120

TEAR ALONG PERFORATED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



THEN JOT DOWN THE
DOPE ABOUT IT ON THIS
FORM CAREFULLY TEAR IT
OUT FOLD IT AND DROP IT
IN THE MAIL

SOMETHING WRONG WITH THIS PUBLICATION?

FROM (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER

TM 5-1940-277-34

PUBLICATION DATE

10 Nov 81

PUBLICATION TITLE

Boat, Bridge Erection, Twin Jet,
Aluminum Hull

BE EXACT PIN-POINT WHERE IT IS

PAGE
NO

PARA
GRAPH

FIGURE
NO

TABLE
NO

IN THIS SPACE TELL WHAT IS WRONG
AND WHAT SHOULD BE DONE ABOUT IT

PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER

SIGN HERE

DA FORM 2028-2
1 JUL 79

PREVIOUS EDITIONS
ARE OBSOLETE
DRSTS-M Overprint 2, 1 Nov 80

P.S. IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR
RECOMMENDATION MAKE A CARBON COPY OF THIS
AND GIVE IT TO YOUR HEADQUARTERS

TEAR ALONG PRIORITIZED LINE